PROGRESS REPORT

(10/1/80 - 9/30/81

Saval Ranch Research and Evaluation Study

Submitted to

Saval Ranch Steering Committee

—in accordance with

Master Cooperative Agreement

among

USDI - Bureau of Land Management

USDA - Forest Service

USDA - Soil Conservation Service

USDA - Agricultural Research Service

Saval Ranching Company

in cooperation with

Nevada Agricultural Experiment Station

Nevada Department of Wildlife

U.S. Geological Survey

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EXECUTIVE SUMMARY

Research progress is presented in detail in another section of this report. For brevity, progress in each discipline is summarized here as follows:

1. Climatology Research- Precipitation, temperature, relative humudity, and evaporation data were collected from instruments installed in 1978. Instrumentation at one location was upgraded to include wind speed and directions, solar radiation and dew point. Greatest annual precipitation, (32.6 in) occurred at a high elevation station, while 11.3 in fell at a lowland station. Precipitation for the calendar year was between 90 and 95% of normal. These near-normal conditions are due to late fall storms in an otherwise low moisture year. At low elevation stations, the 1981 water year precipitation totals were 40 to 45% of the 1980 water year. The 1981 water year precipitation at high elevation stations was 65 to 67% of the 1980 values. Thus, while the 1981 water year was generally acknowledged as quite dry, proportionally more moisture was available for forage production in mountain areas than in the low lying areas. Maximum temperature was 96° F. in August and -16° in February. Pan evaporation was 41.7 in from July 1 to November 16 at one location and 33.3 in from July 1 to October 5, at another location (Neil C. Hutten and Keith R. Cooley).

2. Vegetation Research- Transects were established to monitor vegetation trend of grass, forb, and shrub species by frequency, canopy cover, and density; and soil trend by ground cover characteristic. Vegetation was estimated by the SCS to be in "fair" condition on 44 study areas, "good" condition on 17 areas and "excellent" range condition on 1 area.

The average crested wheatgrass frequency on the Darling seeding (69%) was significantly lower than on the privately owned Tremewan seeding (85%). Also in the Darling Seeding, total shrub cover (5%) and shrub density (14,000 plants/ac) were higher than in the Tremewan seeding (3% and 2,000 plants/ac, respectively). In both the seedings, well over half the total shrub population (75% in the Darling and 60% in the Tremewan) is composed of seedling and young plants.

Grazing use on the various range sites was estimated by utilization classes to identify cattle preferences between range sites, and changes in species and range site preferences for the 1980 and 1981 grazing seasons. During the early summer grazing period of both years, Wet Meadow and Aspen Woodland Range Sites received the heaviest use. In late summer, utilization was again heaviest on the meadow sites but use on the aspen woodlands was much lower than in early summer.

Herbaceous production was sampled on 7 range sites during the 1981 growing season. The highest production was 3229 lb/ac on the Wet Meadow 10-16" p.z. Range Site. Production on upland sites was highest (584 lb/ac) on the Steep North Slope 14-18" p.z. Range Site and lowest (49 lb/ac) on the Claypan 10-12" p.z. Range Site. Crested wheatgrass produced 231 lb/ac (D. Waive Stager and Richard E. Eckert, Jr.).

3. Sage Grouse Research- Sage grouse populations were studied on the Saval Allotment using direct counts and telemetry procedures. Over 130 telemetry locations were marked for later habitat documentation. Seventy-six of these sites were eventually sampled. At each habitat plot, shrub structure, frequency and canopy cover, of plant species, and ground cover data were recorded.

In addition to the above, baseline information was collected on sage grouse use in the Lower Sheep Creek pasture in order to evaluate the effects of sagebrush control and seeding in this pasture. Major vegetation types were mapped, and characterized using the same vegetation measurements mentioned above. Sage grouse dropping transects were established in each location of each of these vegetation types in order to document use distribution.

Sage grouse populations on the study area have undergone a drastic decline in the last 2 years. Weather is probably one of the major reasons for this decline. Many of the yearly activities of grouse were severely altered by poor vegetation conditions due to poor winter precipitation and periods of cold, wet weather during the hatch and early brood-rearing periods. At the present time we cannot document the effect of weather on sage grouse movements and habitat use.

Summer and fall habitats of sage grouse are characteristically combinations of one or more discreet vegetation types. Islands of big sagebrush within larger areas of early (low) sagebrush were heavily utilized for nesting, feeding, and loafing activities. Brood-rearing areas were concentrated along stringer meadows and drainage bottoms where large amounts of habitat edge were common. The dropping transects in Lower Sheep pasture substantiate the same mosaic of habitat utilization patterns. Meadow areas in Lower Sheep Creek were also important (Mack Barrington, Dan Delaney, and Donald A. Klebenow).

4. Mule Deer Research- Seven mule deer fawns are being reared and trained for use in food selection research to be initiated in May, 1982. Fourteen deer were captured and tagged on the Project area during the past year and nine were fitted with radio transmitters. Three remained on the Project area through the winter, probably a result of mild winter conditions. Others migrated to winter ranges in the Adobe Mountains, Tuscarora Mountains, Jerritt Canyon in the Independence Mountain Range, and to the Carlin area. The six deer that left the study area did so by February 3, 1981. Five deer returned by May 18, 1981 and one returned on June 9. The preseason distribution survey indicated a continued increase in the deer population. A majority of the deer sighted during the distribution survey were observed in the aspen vegetation type. This reflects a shift from previous surveys when most were found in mountain brush vegetation. Two reasons may explain the change: (1) the past season was extremely dry and deer may have found better forage in the aspen type and; (2) deer may have selected a more dense cover type due to increases human activity related to mining operations and mineral exploration in the past year (Mike Wickersham and Donald H. Klebenow).

5. Non-Game Research- The responses of non-game wildlife to grazing management systems and range improvements was studied. Data collected this year will be used for comparative purposes as the grazing system is implemented and the crested wheatgrass seeding becomes established. Research in 1981 consisted of sampling key animal communities (to determine changes in species diversity and relative abundance), and monitoring representative species.

A total of 1530 rodents were live-trapped on 26 grids located in 11 range sites within 8 pastures. Highest rodent density (13.8/ac) was recorded in the South Slopes 14-18" p.z. Range Site of the South Forest Service Pasture (ungrazed at time of sampling). Average rodent densities were higher in range sites of ungrazed pastures than in equivalent sites of grazed pastures.

Birds were counted on 14 transects in 6 pastures. Bird abundance (all species combined) was highest in a Wet Meadow Range Site in the South Forest Service Pasture. Species diversity was greatest in a Wet Meadow/ Riparian Aspen Range Site in the same pasture. Bird abundance was variable and the relation between abundance in grazed and ungrazed sites was inconclusive.

Results of strip-census transects indicate that black-tailed jackrabbit densities are comparable to last year's high levels on the BLM pastures. Coyote populations also remained high (J. Kent McAdoo and Donald A. Klebenow).

6. Fisheries Research- Four kinds of data were collected: geomorphic/aquatic, riparian or streamside, hydrologic, and biologic. Structurally, Gance Creek is a very dynamic system both between protected and grazed sites and among years. In general, the protected area consistently had the best overall geomorphic/aquatic conditions. Generally, both average stream width and average depth were reduced in 1981 on protected and grazed sites after an unusually dry winter. One of the grazed sites had the best pool-riffle ratio and the protected site had the poorest. Pool quality has fluctuated greatly in response to periods of channel scouring in 1979 and 1981. Scouring was less in 1981 than in 1979 so the relative amount of gravel increased as the fines were removed. Instream vegetation was highest in 1979, but by 1981 was absent in both grazing treatments. The riparian environment is slightly better in the protected area than in grazed areas. Riparian vegetation appears to respond to reduced grazing more quickly than do structural characteristics of the stream. The trout population on Gance Creek was probably at or near carrying capacity of the system in 1980 and a crash was predicted. This prediction was partially indicated in 1981 because trout numbers did not continue to increase but declined slightly It appears that the trout in Gance Creek are Humboldt cutthroat rather than Lahontan cutthroat (William S. Platts and Rodger L. Nelson).

7. Hydrology Research- The Saval hydrology effort evaluates the effects of intensive livestock management on hydrologic responses. This evaluation will be accomplished through research on instrumented watershed, rainfall simulation, and monitoring of main stream water quality and channel stability. Results of 1981 efforts indicate that sediment yield during the snowmelt period was related to peak stream flow by a power function. Infiltration rate on two different soils appeared to increase linearly with vegetation and litter cover. Rainfall depth-duration frequency curves were developed for the Saval study area and for Elko to use in the systems modeling work. A stream flow flood-frequency relationship was developed for Mahala Creek. The SCS curve number method for runoff estimation was applied to the Upper Gance and Mahala Creek basins. A stream channel survey was conducted on Mahala Creek to document changes in channel morphology. A detailed soil and vegetation inventory was completed in the Upper Mahala Creek Pasture. Two small basins in the East Independence-South Pasture were instrumented for measurement of hydrologic response.

8. Livestock Research- Cattle diets from the South Allaback (early) and North Forest Service (late) Pastures in 1980 contained 95 and 81% grass and grass-like forage, respectively. The upland grass species constituted a greater percentage (60%) in the earlier diet with meadow species becoming more important (55%) in the later diet. Forbs and shrubs increased from trace amounts to 12% of the diet in the North Forest Service Pasture.

Percent total and digestible protein decreased in the 1981 diets as the research steers grazed Upper Sheep Creek and North and South Forest Service Pastures, respectively. Percent ADF, digestible dry matter, and forage intake appeared to be similar in the pooled diets for each pasture while percent lignin increased. Higher ADF, lignin and intake values were found for the later diets within each pastures while protein and digestibility decreased.

Calves weighed and eartagged during branding in May, 1980 and 1981 showed no significant weight difference between years and sexes. The sample calves weaned in October, 1980 were significantly ($P<.05$) heavier than 1981 weaned calves. The average daily gain of calves between May and October 1981, and mature cow weights in 1981 were significantly ($P<.01$) less than for the previous year. Thirty nine percent of the sample cows were diagnosed as pregnant in October 1981 (Lynn K. Winer and Charles F. Speth).

9. Economic Research- Producer panels were conducted with Elko County ranchers. The information obtained included management practices, production, and production cost data for a typical ranch. Income and cost information was collected for the Saval Ranch and was used to determine the cost of producing hay, cost of raising livestock, and net ranch income. A comparison of the results from traditional linear programming and COPLAN showed that both gave similar solutions but that the former is best suited to the multi-year analysis of grazing systems while the latter refers to a solution at one point in time. Linear programs were developed for BLM and FS grazing activities, for improvement in the efficiency of use of federal lands, and for costs of moving livestock from one forage source to another. An inter-industry input-output model was developed for Elko County. The model can determine how the ranching industry relates to other industries and the impacts that increases or decreases in cattle sales can have on the total community (Lee Garoian and Gordon Myer).

10. Integration and Modeling- Phase I of the Saval Ranch Research, Design, Integration, and Synthesis is now complete. Two workshops were conducted. The first workshop, held in November 1981, was the most intensive of labor and time. The workshop lasted 5 days and involved participants from most of the agencies working on the Saval Project. The major product was an initial Saval Ranch simulation model representing the dynamics of the biophysical system including livestock, soils, vegetation, hydrology, and wildlife. After the workshop a substantial model documentation and refinement period occurred based on participant responses at the end of the workshop. The second workshop was held in January 1982. Over a 3 day period the participants evaluated and modified the 1982 research plans using the refined model as a focus of discussion. Particular consideration was given to the timing, frequency, and spatial extent of the data collection. Following this meeting a report was prepared describing the work done with recommendations. This report is now out for review.(ESSA, Ltd.).

INTRODUCTION

The Saval Ranch Research and Evaluation Study was initiated in May, 1978. The overall objective of the study is to evaluate the effects of livestock grazing management systems and necessary range improvement practices on livestock production, vegetation, fish and wildlife and their habitat, watershed hydrology, water quality, economic factors, and other resource values on the Saval Ranch Allotment. This allotment contains 59,000 acres; 14,000 acres are privately owned, 28,000 acres are managed by the Bureau of Land Management, and 17,000 acres managed by the Forest Service.

A Steering Committee is responsible for the development of the overall plans and actions needed to accomplish the study. This committee consists of technical representatives from each Federal agency involved, University of Nevada College of Agriculture Cooperative Extension Service, Nevada Department of Wildlife, Nevada Cattleman's Association, and the Saval Ranch owner and manager.

Progress since 1978 includes an Order III Soil Survey, a delineation of range sites classified to range condition class, a SVIM Inventory, a Cultural Resource Inventory, collection of baseline data on all resources, an Environmental Assessment, a Coordinated Management Plan, and various range improvements. The Management Plan calls for an interim grazing schedule from 1981 to 1984. Full implementation of the management plan is scheduled for 1985 and will include season of use, deferred grazing and no grazing treatments. The plans for monitoring trends in resources and for research are about complete. Figure i-1 shows the existing pasture system on the Saval Allotment. The scheduled grazing use, actual use, and estimated AUM's for the 1981 grazing season are shown in Table i-1.

This interim report summarizes progress and results for the Saval Project for the period October 1, 1980 through September, 30, 1981. Data collection, analyses, and reporting are according to the Master Memo of Understanding and the 1981 Work Plan. The 1981 Work Plan preceeds the various progress reports.

Common names for plants and animals are used in this report. Scientific names are give in Appendix I for plants and Appendix II for animals. The English system of measurement is used in this Report. Factors to convert these measurements to the metric system are presented in Appendix III.

Integration, modeling, and research design studies were not part of the 1981 Work Plan. However, we have included progress on these aspects of the total Project in order to show how the various disciplines are linked together into a coordinated research effort.

Additional copies of this report or further information on work in progress can be obtained from:

Agricultural Research Service
Renewable Resource Center
University of Nevada, Reno
920 Valley Road
Reno, Nevada 89512
Attn. R. Eckert Jr.

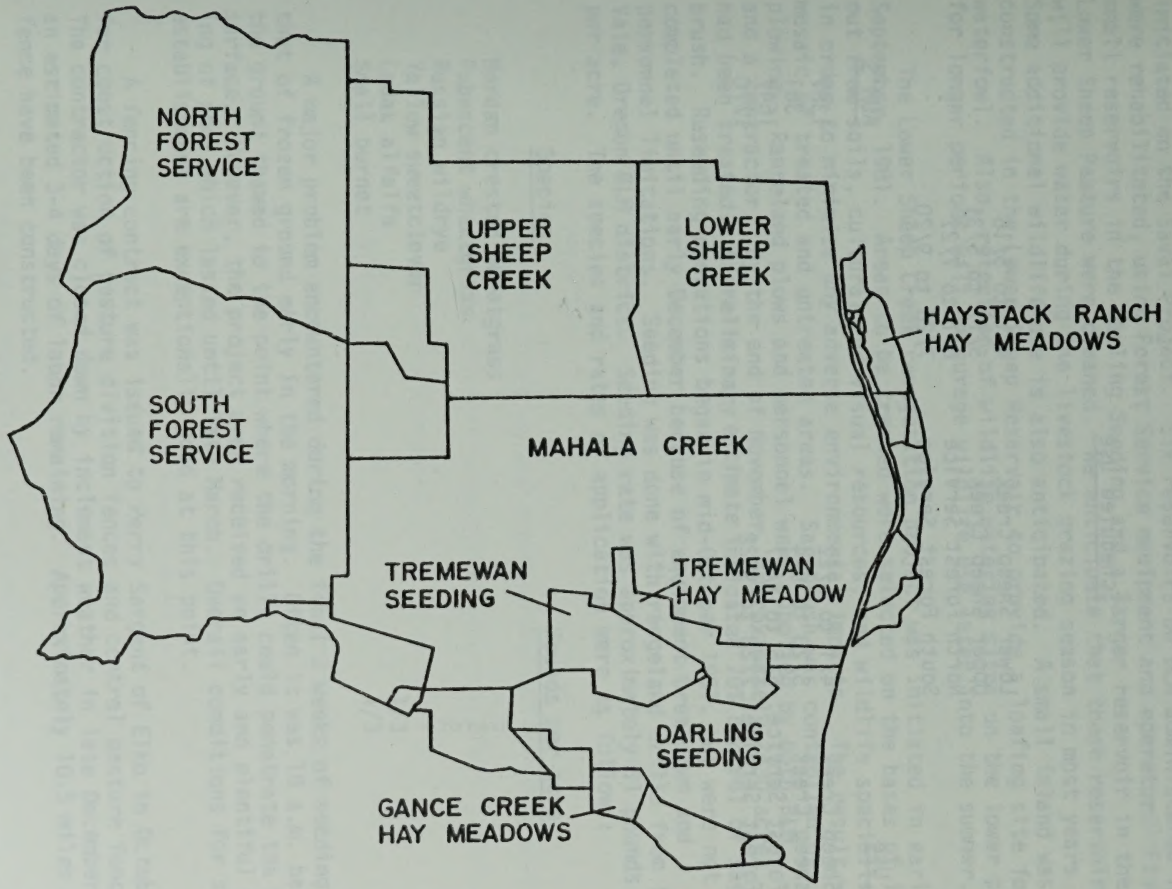

Figure i-1. Crested wheatgrass seeding, native BLM and FS pastures, and private hay meadows on the Saval Ranch Allotment.

Table i-1. Planned and estimated actual use and estimated AUM'S used in each pasture grazed in 1981.

Scheduled Use

Lower Sheep Creek	4/1 to 5/16
Upper Sheep Creek	5/17 to 5/31
North Forest Service	6/1 to 7/27
South Forest Service	7/28 to 9/20

Acutal Use		AUM'S
Lower Sheep Creek	4/1 to 5/22	1387
Upper sheep Creek	5/23 to 6/4	361
North Forest Service	6/5 to 7/27	1647
South Forest Service	7/28 to 9/22	1770

1981 RANGE IMPROVEMENTS

Beginning in August 1981, several range improvement projects were initiated on the Saval Project. Six reservoirs on BLM administered lands were rehabilitated, using Forest Service equipment and operator. Five small reservoirs in the Darling Seeding and a larger reservoir in the Lower Sheep Pasture were cleaned. We anticipate that these reservoirs will provide water during the livestock grazing season in most years. Some additional wildlife use is also anticipated. A small island was constructed in the Lower Sheep Reservoir to provide a loafing site for waterfowl. Also, retention of wildlife watering sites on the lower pastures for longer periods will encourage wildlife use later into the summer.

The Lower Sheep Creek revegetation project was initiated in early September, 1981. Areas to be treated were selected on the bases of input from soils, cultural and visual resources, and wildlife specialists in order to minimize any adverse environmental impacts. The result was mosaic of treated and untreated areas. Sagebrush was controlled by plowing. Rangeland plows and personnel were supplied by both BLM and a contractor. By the end of November, approximately 2430 acres had been treated. A preliminary estimate indicated 70% control of sagebrush. Reseeding operations began in mid-October 1981, but were not completed until early December because of equipment breakdown and personnel limitations. Seeding was done with rangeland drills from the Vale, Oregon BLM district. Seeding rate was approximately 11 pounds per acre. The species and rates of application were as follows:

Species	Pounds per acre
Nordan crested wheatgrass	5
Pubescent wheatgrass	2
Russian wildrye	2
Yellow sweetclover	1
Ladak alfalfa	1/3
Small burnet	1/3

A major problem encountered during the final 2 weeks of seeding was that of frozen ground early in the morning. Often it was 10 a.m. before the ground thawed to the point where the drills could penetrate the soil surface. However, the project area received an early and plentiful covering of snow which lasted until late March. Overall conditions for stand establishment are exceptionally good at this point.

A fencing contract was issued to Perry Sargent of Elko in October 1981 for construction of pasture division fences and control pasture fences. The contractor was closed down by inclement weather in late December with an estimated 3-4 days of labor remaining. Approximately 10.5 miles of fence have been constructed.

A contract was opened for bid in late March 1982 for construction of four new cattleguards on the project area. These cattleguards will be placed on main roads where the new fences were constructed. Work is scheduled to begin in early April, 1982 with completion in approximately 30 days.

The Jim Creek pipeline is the only remaining project scheduled for completion in fiscal year 1982. This pipeline will augment the existing system with water from a more reliable source to feed a series of troughs in the Upper and Middle Mahala Creek Pastures. This project should be completed by mid-summer of 1982 (Terry Dailey).

1. Vegetation Research

Complete data collection on existing trend plots and establish additional plots on extensive and/or important upland and riparian range sites. Determine phenology and degree of utilization of forage species on important range sites. Collect samples for fecal analysis on some range sites. Cooperate with economist and animal scientist to determine forage yield on important range sites and yield and quality of hay aftermath.

2. Annual Wildlife Inventory

The annual wildlife inventory conducted by the Nevada Department of Wildlife will consist of:

a. preseason herd composition and harvest data for mule deer.
b. sage grouse strutting ground counts and brood survey for upland game birds.
c. waterfowl breeding and brood survey and mourning dove counts,
d. ground inventory of identified non-game and fur bearer population and nest site occupancy.

3. Wildlife Research

Describe characteristics of seasonal habitats used by a marked sample of sage grouse and mule deer. Initiate study of diet overlap between cattle and mule deer as influenced by season of use, forage utilization, and range condition.

4. Non-Game Research

Initiate intensive sampling of non-game wildlife populations in key plant communities to determine density and species diversity of rabbits, rodents, and birds in response to vegetation changes in each community.

5. Climatology and Hydrology

Continue maintenance of climatological instruments including equipment service, data collection, and general data summarization. Contunue water quality monitoring at selected stream sampling sites. Participate, as needed, in watershed related activities of the Forest Service, BLM, and ARS.

6. Livestock Research

Grazing studies will evaluate the quantity and quality of forage consumed by cattle. Rumen fistulated and intact steers will be used. Cow and pasture productivity will be measured by periodic calf weights during the grazing season and at weaning. Botanical composition comparisons will be made between rumen and fecal samples from animals grazing in common areas.

7. Economic Research

a. Repeat the budgeting analysis for the Saval Ranch in order to determine average yearly (1980 and 1981) costs of production,

b. build a static, single-year linear programming model for the Saval Ranch. Incorporate data collected by other groups and the costs calculated from budget analysis into the model. "Fine-tune" the model.

CHAPTER 1

CLIMATOLOGY RESEARCH

Neil C. Hutten and Keith R. Cooley

1981 Objectives:

1) To document the climatic regime of the study area.
2) To provide a reference for extrapolation of resource data to other sites.
3) To provide data input to the hydrological studies undertaken within the Saval Project.
4) To provide data input for other study disciplines including vegetation, wildlife, and livestock.

1981 Accomplishments:

A climatic monitoring network for the Saval study area was designed and instruments installed in 1978. The locations of the various stations and climatic instruments are shown in Figure 1-1. Elevations of these stations are shown in Table 1-1.

Precipitation, temperature, and evaporation data will be utilized as driving variables and test data for procedures such as rainfall-runoff, soil moisture, and forage production modeling. The information may also be used to correlate climatic events with wildlife population responses and irrigation water availability.

Station 2 was upgraded this year with electorical power and several new instruments. These instruments are a wind speed and direction recorder, an integrater and a digital printer to record output from a solar radiation detector (pyranometer), and a dew point recorder. These are housed in an existing building. Outside this building, within the station compound, a wind mast was erected and wind speed and direction transmitters were installed. The pyranometer was attached to the roof of the building. The dew point probe was installed in the existing thermograph shelter.

Precipitation. Quarterly precipitation totals in the 1980-1981 water year and the 1981 calendar year are given in Table 1-2. The rather large differences noted between water year totals and calendar year totals are due to the large contrast in fall 1980 and fall 1981 precipitation. This contrast is readily evident when fourth quarter totals for the 2 years are compared.

Comparisons of this water year and calendar year are made with the 2 previous water and calendar years of record on the study area (Table 1-3). The late fall storm events on the study area brought calendar year 1981 totals up to values very similar to 1980 values. Precipitation totals for the Elko and Owyhee weather stations in 1981 were 89% and 98% of normal, respectively. Based on the location of the Saval study area, precipitation totals for the 1981 calendar year are estimated to range between 90 and 95% of normal. These near-normal conditions are due to the late fall storms in an otherwise low moisture year. These fall events may have a positive

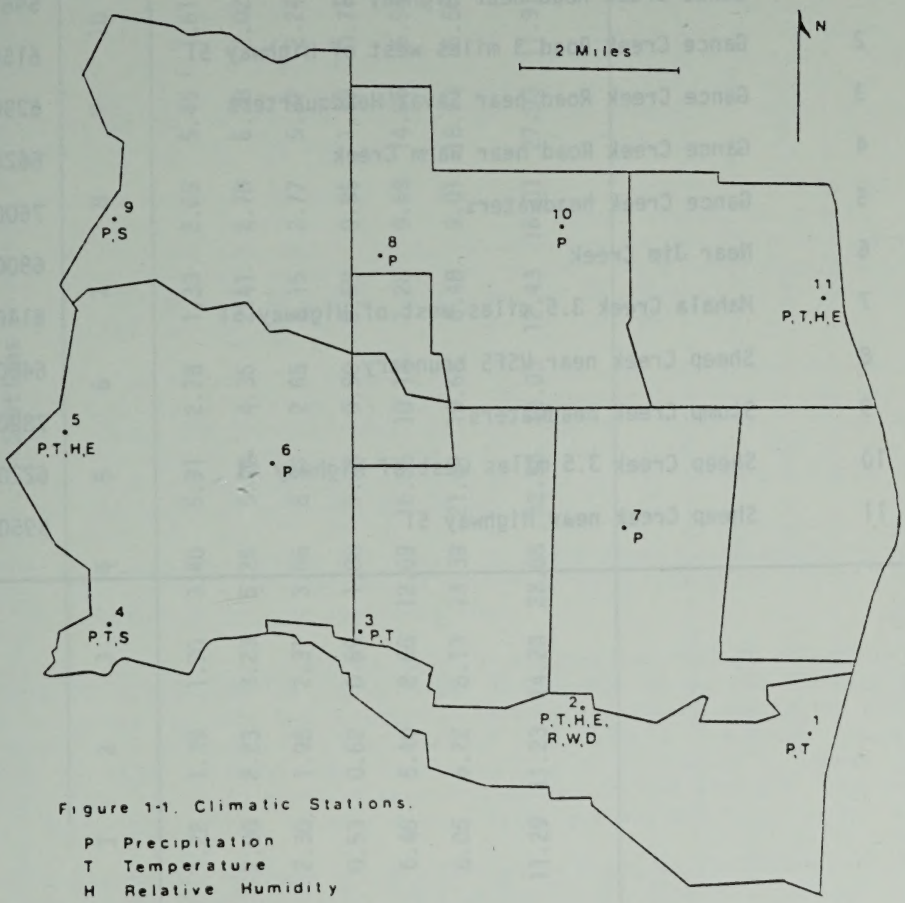

Figure 1-1. Climatic Stations.

- P Precipitation
- T Temperature
- H Relative Humidity
- E Evaporation
- R Solar Radiation
- W Wind Speed and Direction
- D Dew Point Temperature
- S Snow Course

Table 1-1. Station numbers, locations, and elevations.

Number	Location	Elevation (feet)
1	Gance Creek Road near Highway 51	5960
2	Gance Creek Road 3 miles west of Highway 51	6150
3	Gance Creek Road near Saval Headquarters	6290
4	Gance Creek Road near Warm Creek	6620
5	Gance Creek headwaters	7600
6	Near Jim Creek	6800
7	Mahala Creek 3.5 miles west of Highway 51	6140
8	Sheep Creek near USFS boundary	6480
9	Stump Creek headwaters	7820
10	Sheep Creek 3.5 miles west of Highway 51	6220
11	Sheep Creek near Highway 51	5950

Table 1-2. Quarterly precipitation (in inches) for the Saval study area.

Quarter	Stations										
	1	2	3	4	5	6	7	8	9	10	11
1980 -4	1.22	1.39	1.90	3.40	5.91	2.78	1.33	2.69	5.45	1.61	1.39
1981 -1	2.00	2.23	3.23	5.25	5.98	4.35	2.41	2.70	6.28	2.02	1.96
1981 -2	2.30	1.98	2.31	3.66	8.37	2.65	2.15	2.77	5.31	2.24	2.49
1981 -3	0.53	0.62	0.69	1.08	1.35	0.90	0.59	0.85	1.49	0.71	0.40
1981 -4	6.46	6.40	8.05	12.69	16.85	10.13	7.28	9.69	14.85	6.94	7.08
Water Year 1981 Total	6.05	6.22	8.13	13.39	21.61	10.68	6.48	9.01	18.53	6.58	6.24
Calendar Year 1981 Total	11.29	11.23	14.28	22.68	32.55	18.03	12.43	16.01	27.93	11.91	11.93

Table 1-3. Comparisons of precipitation values (in inches) at 11 stations for Water and Calendar Years 1979, 1980, and 1981.

Station Number	Water Year 1978-1979[1]	Water Year 1979-1980	Water Year 1980-1981	Calendar Year 1979	Calendar Year 1980	Calendar Year 1981
1	6.12	14.61	6.05	8.50	13.30	11.29
2	5.45	13.26	6.22	7.40	12.50	11.23
3	7.41	15.31	8.13	10.11	13.91	14.28
4	9.56	23.46	13.39	14.50	21.72	22.68
5	9.93	33.08	21.61	15.35	32.87	32.55
6	-[2]	-	10.68	-	13.53	18.03
7	7.91	13.76	6.48	9.84	12.66	12.43
8	8.18	13.96	9.01	10.74	13.44	16.01
9	13.63	27.71	18.53	19.29	26.85	27.93
10	6.41	13.09	6.58	8.88	11.93	11.91
11	7.40	13.82	6.24	9.73	12.63	11.93

[1]Data gathering in 1978 began between October 20 and October 30, 1978, at the various stations. Thus, any precipitation that may have occurred in early October 1978, is not included here.

[2]Station moved, no data recorded.

effect on forage production in 1982 as well as on the success of the seeding in the lower Sheep Creek pasture. Irrigation should also be sustained for a longer period through the growing season in 1982 than it was in 1981.

At the low elevation stations (Stations 1 and 11) the 1981 water year had precipitation totals which were 40 to 45% of the 1980 water year. However, at the high elevation stations (5 and 9) a similar comparison shows precipitation values in water year 1981 at 65 to 67% of 1980 values. Thus, while water year 1981 was generally acknowledged as quite dry, there was proportionately more moisture available for forage production in the mountains than in the low lying areas.

A regression equation relating the average annual precipitation to the station elevation is shown in Figure 1-2. The annual average is based only on the 1980 and 1981 water years, and does not include Station 6 (elevation 6800 feet) that was moved during this period. This relationship may be used to give an estimate of annual precipitation at other sites on the study area, if needed.

Cumulative percentages of annual precipitation were determined for water years 1980 and 1981 at Stations 2 and 5. The average of these values was taken on a weekly and biweekly basis at each station. Results of these calculations are shown in Figures 1-3 and 1-4. At both stations, 90% of the precipitation for those years occurred by June 1. The greatest rates of increase at both stations occurred during May.

Daily precipitation totals and totals on a per storm basis are being calculated and compiled at the Northwest Watershed Research Center (Boise - ARS). The 1981 information will be available soon.

Temperature and Relative Humidity. Monthly maximum and minimum temperatures for both the water year and the calendar year months at the six thermograph sites are shown in Table 1-4. Summer high temperatures ranged in the low to mid 90's with a maximum of 96 F at Station 1 in August. The lowest temperature on the study area was -16 F in February, also at Station 1. More commonly, the low lying stations experienced temperature minimums from -10 to 10 F. Daily temperature values are available, but not presented here.

Daily maximum and minimum values of relative humidity (RH) have not yet been summarized. Variability in these values is due more to localized storm events than to the season of the year. Thus RH values of 90 to 100% have occurred during mid-summer thunderstorms and during temperature minimums. Minimum RH values of 15% have occurred during the warm, dry summer afternoons. Winter RH values commonly fluctuate between 40 and 100 percent.

Evaporation. Standard National Weather Service Class A evaporation pans were installed during the 1981 field season at Stations 2 and 11. Both pans rest on wooden pallets on the ground surface. Station 2 is surrounded by a crested wheatgrass seeding with scattered Wyoming big sagebrush invading. The vegetation surrounding Station 11 is predominantly Wyoming big sagebrush.

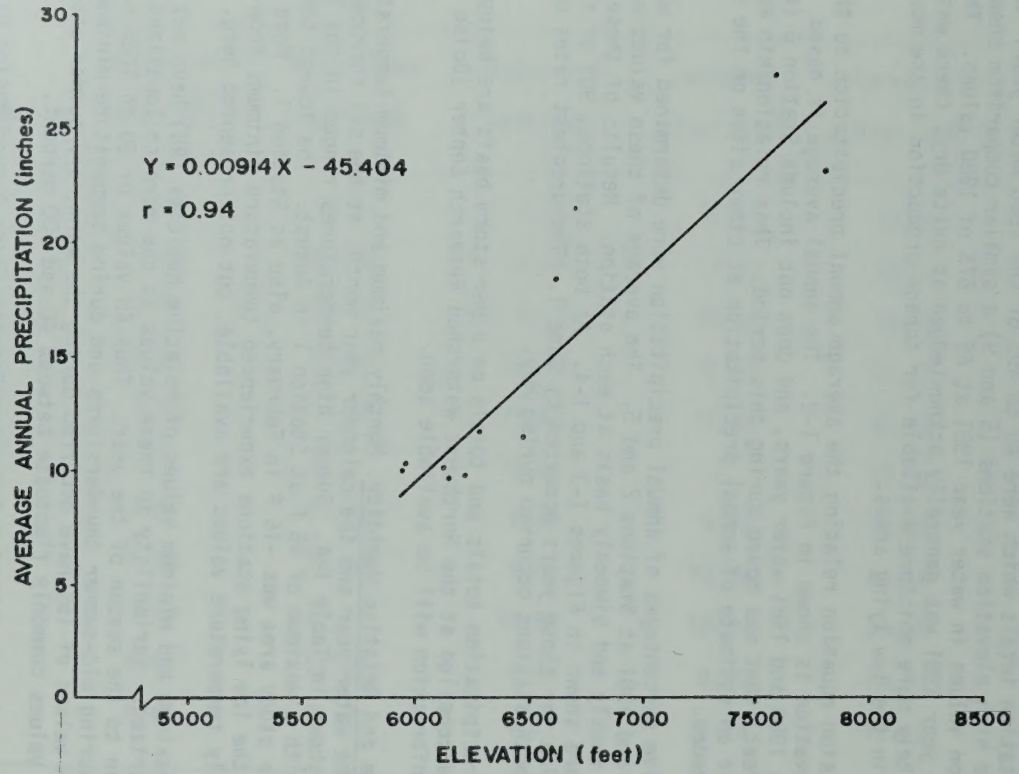

Figure 1-2. Simple linear regression showing the relationship of average annual precipitation for water years 1980 and 1981 versus elevation for ten precipitation stations.

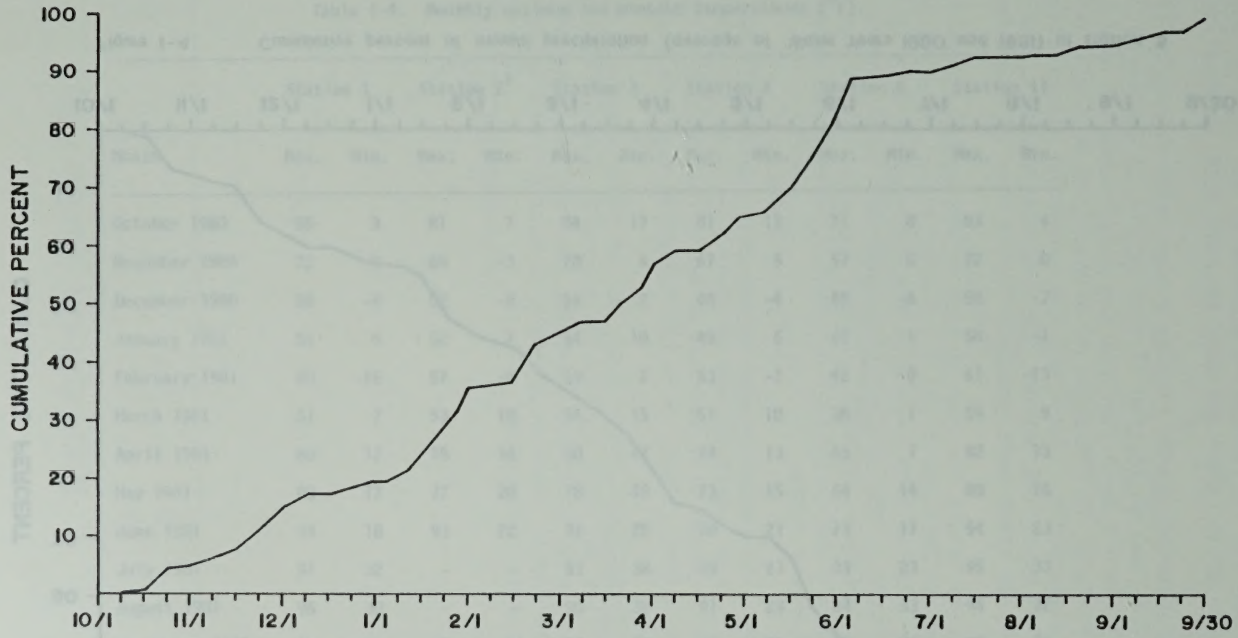

Figure 1-3. Cumulative percent of annual precipitation (average of Water Years 1980 and 1981) at station 2.

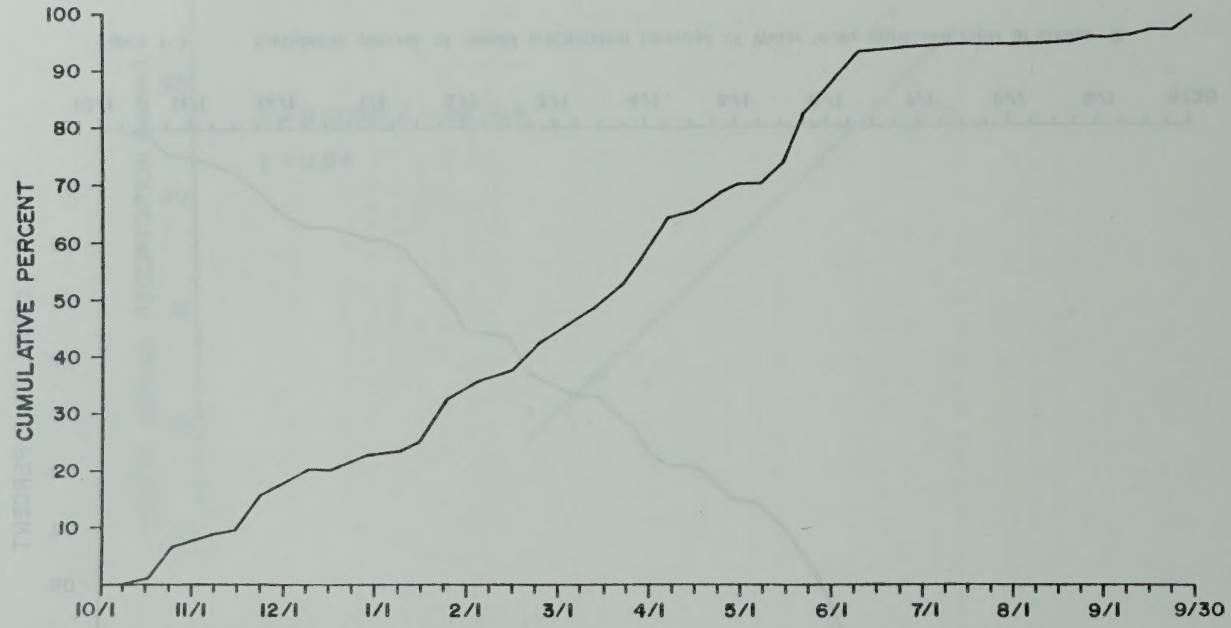

Figure 1-4. Cumulative percent of annual precipitation (average of Water Years 1980 and 1981) at station 5.

Table 1-4. Monthly maximum and minimum temperatures (°F).

Month	Station 1		Station 2[1]		Station 3		Station 4		Station 5		Station 11	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
October 1980	85	3	81	7	84	17	81	13	71	8	83	4
November 1980	72	0	69	-3	70	4	67	5	57	0	72	0
December 1980	56	-4	52	-8	56	2	48	-4	49	-6	58	-7
January 1981	56	5	52	7	54	10	49	6	42	1	56	-1
February 1981	60	-16	57	-8	59	2	53	-2	42	0	61	-13
March 1981	57	7	53	10	56	15	51	10	38	1	59	9
April 1981	80	12	78	14	80	17	74	13	65	7	82	13
May 1981	80	17	77	20	78	19	73	15	64	14	80	16
June 1981	94	18	93	22	92	25	90	21	73	17	94	23
July 1981	94	32	-	-	93	38	89	23	83	23	95	33
August 1981	96	30	-	-	95	38	91	29	84	33	94	32
September 1981	89	18	87	24	87	29	84	23	80	26	88	21
October 1981	75	11	79	17	72	20	69	13	64	15	73	13
Nobember 1981	67	2	65	3	65	8	62	4	59	9	65	3
December 1981	55	-3	54	1	55	3	49	3	50	5	55	-1

[1] Instrument calibrations were made in July and August at Station 2, no data recorded during that time.

Evaporation from both pans was determined by a centimeter hook gage in a stilling well inside the north rim of the pan. Water levels were recorded every 2 to 7 days. The pans were refilled when the water level was 3 inches or more below the rim. A totalizing anemometer was used to measure the total wind movement, in miles, over the pans between each observation.

Evaporation observations at Station 2 were made from July 1, 1981, to November 16, 1981, and at Station 11 from July 1 to October 5, 1981. The mean rate of evaporation for both stations was 0.32 inches per day. Figures 1-5 and 1-6 show the range in the rates of evaporation at Stations 2 and 11 during the period of measurement. These are the corrected values after accounting for precipitation occurring between the observation dates. As would be expected, evaporation rates were greatest during late July and early August.

Pan evaporation totals for the periods of measurement were 41.70 inches and 33.33 inches at Stations 2 and 11, respectively. The nearest National Weather Service station with available pan evaporation data is Beowawe in northeastern Nevada. Total evaporation there was 40.47 inches for the period June 1 through September 30, 1981. Annual pan evaporation totals are typically multiplied by a pan coefficient of 0.6 to 0.7 to estimate annual lake and reservoir evaporation rates.

Solar Radiation. The recording and integrating instruments for the pyranometer apparently have a malfunction in their logic circuitry. The data recorded in the 1981 field season will be re-examined after the exact cause of the malfunction is determined. Thus, no solar radiation data are presented.

Wind Speed and Direction. Wind speeds on the study area generally vary between 0 to 20 miles per hour and rarely exceed 25 mph during the growing season. However, a 36 to 40 mph wind was recorded in November 1981, with an approaching cold front. More detailed wind data are available, but for brevity are not presented in this report.

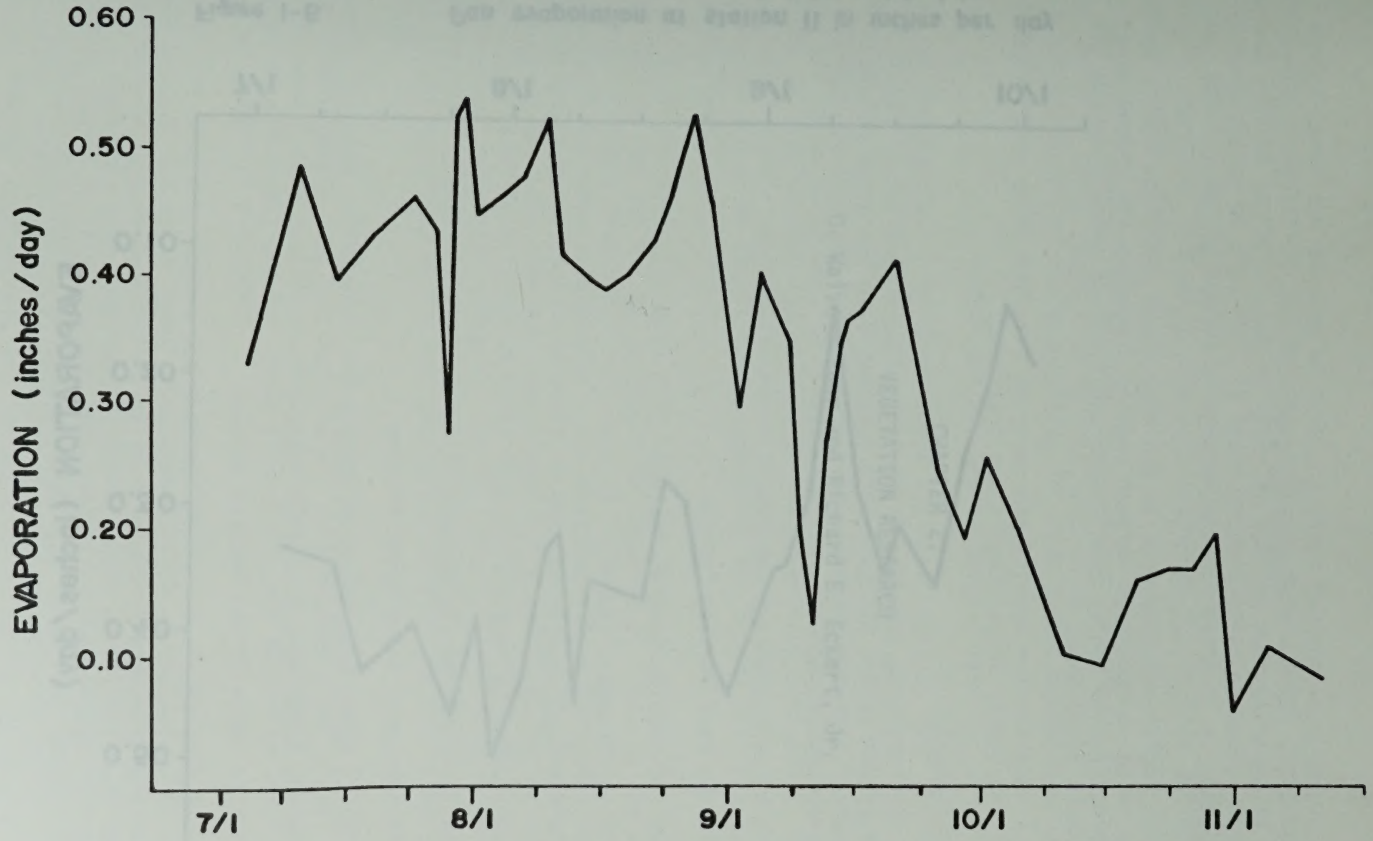

Figure 1-5. Pan evaporation at station 2 in inches per day for each observation period from July 1 to November 16, 1981.

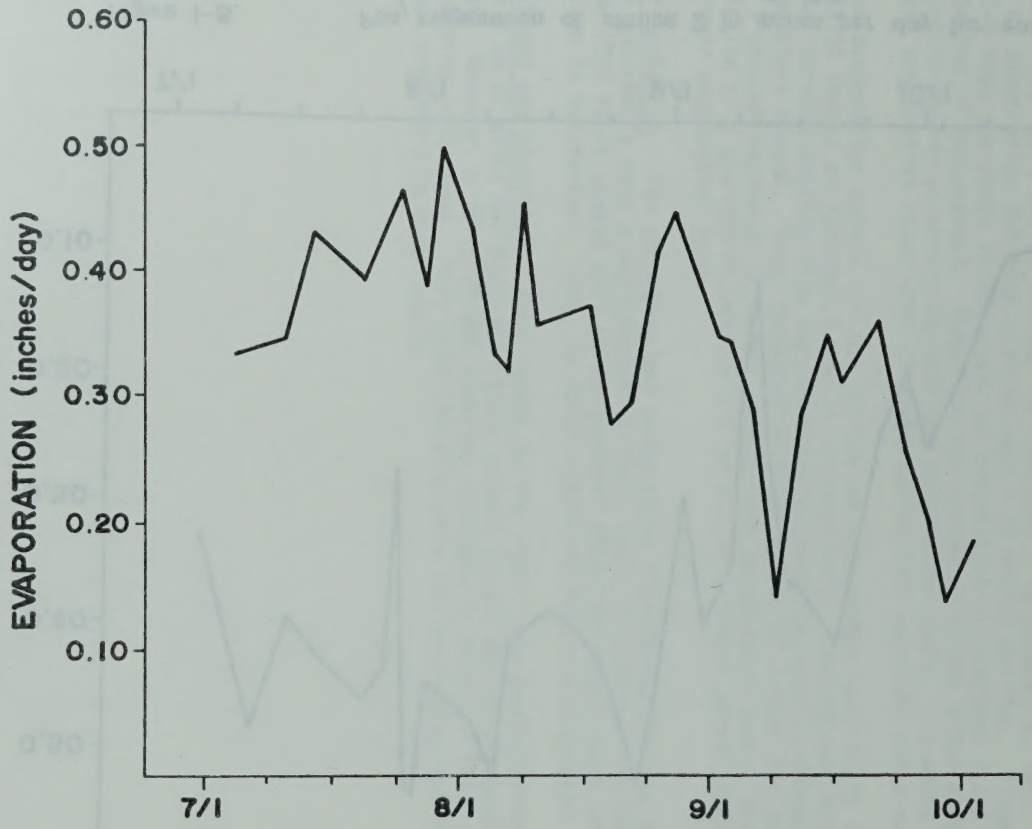

Figure I-6. Pan evaporation at station II in inches per day for each observation period from July 1 to October 5, 1981.

CHAPTER 2.

VEGETATION RESEARCH

D. Waive Stager and Richard E. Eckert, Jr.

Vegetation Trend

1981 Objectives:

1. Establish additional transects to estimate range condition and to monitor the trend in condition through species frequency and ground cover characteristics on the various upland and riparian range sites on the Saval Ranch study area.

2. Initiate sampling for density and cover of tree and shrub species on new and previously established trend transects.

1981 Accomplishments:

In the 1981 field season 37 additional transects were established: 11 in meadow sites, 5 in the Middle Mahala pasture, 5 in the Upper Mahala pasture, and 16 in the South Forest Service pasture. The total number of trend plots is now 131 over the project area:

1 in the East Darling Seeding

5 in the West Darling Seeding

6 in the Seeding Control Pasture

4 in the Tremewan Seeding

1 in the Lower Mahala Pasture

6 in the Middle Mahala Pasture

7 in the Upper Mahala Pasture

3 in the Lower Sheep Creek Pasture

14 in the Upper Sheep Creek Pasture

24 in the South Forest Service Pasture

21 in the North Forest Service Pasture

39 in meadow sites

All of these transects have been sampled for species frequency and ground cover characteristics with the methodology described by Gordon Lymbery and R.E. Eckert in the 1979 Progress Report and in the "Vegetation Sampling Procedure" section of the Saval Research and Evaluation Project Proposal.

Canopy cover and density of tree and shrub species were sampled this field season on transects in the Darling seedings, Mahala Creek pastures, and South Forest Service pasture. Canopy cover by species was estimated by the line intercept method on six, 49.2 ft lines perpendicular to each transect's base line. Density was collected by species and age class (i.e., seedling, young, mature, decadent, and dead) from belt transects 3.3 ft wide on the same lines used to sample cover.

The Soil Conservation Service (SCS) visited most of the non-meadow sites and verified their range site designations. The SCS has also provided a visual estimation of range condition for each transect sample area (Table 2-1 and 2-2).

Upland and Dry Meadow Range Sites

Crested Wheatgrass. Live shrub cover and shrub density data collected in 1981 from transects established last year in the crested wheatgrass seedings are shown in Table 2-3. Analysis of variance tests on these data were made at a probability level of 5 percent. In the Tremewan seeding, total shrub cover (3%) and total shrub density (2000 plants/ac) are both significantly lower than in the Darling seeding (5% and 14,000 plants/ac, respectively). For a discussion of the different treatments these seedings have received, which may account for the results presented here, see Stager and Eckert, 1980 Saval Annual Report.

In both the seedings, well over half the total shrub population (75% in the Darling and 60% in the Tremewan) is composed of seedling and young plants. If most of these immature shrubs survive to maturity the total amount of shrub cover will increase substantially and there will be a corresponding decrease in the amount of crested wheatgrass on the seedings. The frequency of crested wheatgrass on these seedings (see Stager and Eckert 1980 for values) is inversely related to both shrub cover ($r = -0.54$) and shrub density ($r = -0.64$) as shown by regression analysis. An increase of 5% in shrub cover, or an increase in shrub density of 19,000 plants/ac, would result in a decrease of 11% in the frequency of crested wheatgrass (4.9 in x 4.9 in sampling frame size).

Mahala Pastures. Frequency and ground cover data are shown in Table 2-4 for the Middle Mahala (MM) and Upper Mahala (UM) pasture trend plots. Shrub cover and density data for these trend plots are summarized in Table 2-5. The range site designations for these trend plots are tentative until the SCS soil survey report is published.

In the Mahala pastures, the Claypan 10-12" p.z. Range Site covers 32% of each pasture and is in "good" condition (51-75% of the potential production) according to the SVIM survey clipping results (updated with the most recent soil survey and range site descriptions). The SCS estimated "fair" condition (26-50% of the potential production) on this range site represented by our transects in the Mahala pastures. In the SCS range site description, the potential vegetation on this Claypan site is dominated by bluebunch wheatgrass, Thurber needlegrass, and low sagebrush. As the SCS ecological condition deteriorates, low sagebrush, bottlebrush squirreltail, and Sandberg bluegrass increase.

Table 2-1. Summary by range site and condition class[1] of trend transects in the BLM pastures of the Saval Ranch.

	Darling Seedling		Lower Mahala (LM)			Middle Mahala (MM)			Upper Mahala (UM)			Lower Sheep (LSC)			Upper Sheep (USC)			Total		
Range Site	%[2]	Unclassified[3]	%	Fair[4]	Good[5]	%	Fair	Good	%	Fair	Good	%	Fair	Good	%	Fair	Good	Fair	Good	Unclassified
Crested Wheatgrass	80	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Loamy 8-10"	13	0	84	1	0	46	1	0	13	0	0	79	1	0	30	1	0	4	0	0
Loamy 10-12"	0	0	T[6]	0	0	18	1	0	23	2	1	T	0	0	21	1	2	4	3	0
Loamy Slope 10-14"	0	0	0	0	0	0	0	0	16	3	0	0	0	0	5	2	1	5	1	0
Loamy Bottom 8-14"	0	0	0	0	0	3	1	0	3	0	0	6	1	0	8	1	0	3	0	0
Claypan 10-12"	5	0	15	0	0	32	3	0	32	1	0	14	1	0	32	4	0	9	0	0
Claypan 12-16"	0	0	0	0	0	0	0	0	11	0	0	0	0	0	4	2	0	2	0	0
Upland Browse 12-16"	0	0	0	0	0	0	0	0	1	0	0	0	0	0	T	0	0	0	0	0
Wet Meadow 8-16"	1	0	T	0	0	T	0	0	T	0	0	T	0	0	T	0	0	0	0	0
Total		12		1	0		6	0		6	1		3	0		11	3	27	4	12

[1]Condition was visually estimated by SCS personnel.

[2]Percent by area of range site within each pasture from SVIM survey results.

[3]For various reasons, some trend transects could not be given a condition estimate.

[4]26-50% of the potential production is currently produced on the site.

[5]51-75% of the potential production is currently produced on the site.

[6]<1% of the pasture area.

Table 2-2. Summary by range site and condition class[1] of trend transects in the USFS pastures of the Saval Ranch.

	South Forest Service (SFS)					North Forest Service (NFS)					Total			
Range Site	%[2]	Fair[3]	Good[4]	Exc.[5]	Unc.[6]	%	Fair	Good	Exc.	Unc.	Fair	Good	Exc.	Unc.
Loamy Slope 10-14"	4	1	0	0	0	4	0	2	0	0	1	2	0	0
Loamy Slope 14-18"	15	0	1	0	0	5	1	1	0	0	1	2	0	0
Steep North Slope 14-18"	3	0	1	0	0	3	1	0	1	0	1	1	1	0
South Slope 12-14"	17	2	2	0	1	18	1	1	0	0	3	3	0	1
South Slope 14-18"	13	0	2	0	0	9	2	1	0	0	2	3	0	0
Upland Browse 12-16"	T[7]	0	0	0	0	T	0	0	0	0	0	0	0	0
Claypan 12-16"	3	0	1	0	1	11	4	0	0	0	4	1	0	1
Mt. Ridge 14-18"	27	1	0	0	0	21	1	1	0	1	2	1	0	1
Snowpocket 14-18"	2	1	0	0	0	2	0	0	0	0	1	0	0	0
Aspen Thicket 14-18"	9	1	0	0	0	12	1	0	0	0	2	0	0	0
Aspen Woodland	4	0	0	0	6	9	0	0	0	2	0	0	0	8
Dry Meadow 10-16"	T	0	0	0	3	T	0	0	0	0	0	0	0	3
Wet Meadow 8-16"	2	0	0	0	9	1	0	0	0	12	0	0	0	21
Total		6	7	0	20		11	6	1	15	17	13	1	35

[1] Condition was visually estimated by SCS personnel.

[2] Percent by area of range site within each pasture from SVIM survey results.

[3] 26-50% of the potential production is currently produced on the site.

[4] 51-75% of the potential production is currently produced on the site.

[5] 76-100% of the potential production is currently produced on the site.

[6] Unclassified - for various reasons, some trend transects could not be given a condition estimate.

[7] <1% of the pasture area.

Table 2-3. Live cover (%) and density (1000's/acre) of common shrub species on the Saval Ranch's Darling and Tremewan crested wheatgrass seedings taken during the 1981 field season.

Live Shrub Cover (%)

	Darling Seeding											Tremewan Seeding				
Species	1	2	3	4	5	6	7	8	9	10	Average	11	12	13	14	Average
Big Sagebrush	4	0	0	0	0	0	0	1	1	T[1]	T	0	1	0	0	T
Low Rabbitbrush	T	2	1	2	T	0	T	0	1	T	T	2	1	0	T	T
Low Sagebrush	0	3	6	4	4	6	4	1	7	4	4	3	2	2	0	2
Total[2]	5	5	7	6	4	6	4	2	9	5	5	5	4	2	T	3

Shrub Density (1000's/acre)

	Darling Seeding											Tremewan Seeding				
Species	1	2	3	4	5	6	7	8	9	10	Average	11	12	13	14	Average
Big Sagebrush	13	0	0	0	0	0	0	2	2	14	3	0	3	T[1]	T	0.8
Low Rabbitbrush	0.4	2	1	1	0.5	T	0.3	0	1	0.7	0.7	0.9	0.6	0	T	0.4
Low Sagebrush	0	6	11	9	8	13	9	6	9	29	10	0.9	1	1	0.2	0.8
Total[2]	13	8	12	9	8	13	10	8	12	44	14	2	5	1	0.3	2

[1] T < 1% for shrub cover or < 100/acre for shrub density.

[2] Due to rounding, totals may differ from the sum of the column values.

Table 2-4. Frequency (%) of common shrub and grass species and ground cover (%) characteristics on claypan and loamy range sites in the Saval Ranch's Middle Mahala (MM) and Upper Mahala (UM) pastures, taken during the 1979 and 1981 field seasons.

		Shrub Frequency (%)					Grass Frequency (%)											Ground Cover (%)[2]								
Range Site (Pasture)		ARLO	ARTR	CHNA	CHVI	PUTR	AGDA	AGSP	BRTE	CASP	ELCI	FEID	MURI	ORWE	PONE	POSA	SIHY	STTH	VEG	BG	NPL	PL	ROCK	PAVE	CRYP	COP	INTER
Claypan 10-12" (MM)	1	61	0	0	2	0	0	0	1	0	0	0	0	10	0	83[3]	44	21	10	14	34	7	1	35	T[1]	31	60
	2	66	0	0	0	0	0	0	0	0	0	0	0	0	0	46	53	5	12	21	32	5	T	30	T	29	60
	3	64	0	0	0	0	0	0	0	0	0	0	0	2	0	63	71	22	14	11	33	5	T	36	T	32	54
(UM)	1	62	0	0	1	0	0	0	2	0	0	0	0	0	8	68	54	3									
Loamy 10-12" (MM)	1	0	35	0	6	0	0	0	T	0	T	0	0	T	0	44[3]	70	6	17	20	29	12	T	22	T	25	59
	2	0	43	0	5	0	0	0	0	0	0	0	0	0	0	45[3]	43[3]	0	12	18	38	11	T	22	T	20	69
(UM)	1	4	35	0	31	11	0	4	2	0	T	0	0	0	13	40[3]	47	0									
	2	2	40	0	32	3	0	2	T	0	1	0	0	0	0	56[3]	79	9	11	21	50	9	T	7	1	42	47
	3	0	24	0	47	6	0	0	13	0	0	0	0	0	0	83	66	9	9	16	61	10	0	3	1	46	45
Loamy Bottom 8-14" (MM)	1	T	46	6	0	0	41	0	16	59	1	0	9	0	0	4	4	1									
Loamy Slope 10-14" (UM)	1	0	30	0	43	8	0	10	40	0	1	10	0	0	0	62[3]	59	6	4	19	57	18	0	T	T	59	37
	2	0	28	0	36	19	0	10	40	0	2	10	0	0	0	74[3]	57	12	6	15	55	14	T	10	T	47	47
	3	1	32	0	11	18	0	10	37	0	T	T	0	0	0	80[3]	50	5	2	17	47	8	0	26	T	39	59

[1] T < 1%

[2] Ground cover values for 1981 transects only.

[3] 9.8 in x 9.8 in sampling frame used, rather than the standard 19.7 in x 19.7 in frame, due to high frequency.

Table 2-5. Live cover (%) and density (1000's/ac) of common shrub species on Claypan and Loamy Range Sites in the Saval Ranch's Middle Mahala (MM) and Upper Mahala (UM) pastures taken during the 1981 field season.

	Live Shrub Cover (%)									Shrub Density (1000's/acre)								
Range Site (pasture)	AMUT	ARLO	ARTR	CHNA	CHVI	GRSP	PUTR	SYOR	TOTAL[1]	AMUT	ARLO	ARTR	CHNA	CHVI	GRSP	PUTR	SYOR	TOTAL[1]
Claypan 10-12" (MM) 1		9			T[2]				9		6			T[2]				6
2		16				T			16		8				0.1			8
3		9							9		8							8
(UM) 1		23	T		T				24		9	T	T					9
Loamy 10-12" (MM) 1			11		T				11			5		0.8				6
2			12		T				12			5		0.6				6
(UM) 1	T	1	8		9		12		31	T	0.2	6		5		1		12
2			10		5		1		16	T		4		3		0.4		8
3			11		4		7		22			3		4		1		9
Loamy Bottom 8-14" (MM) 1			30	7					37			10	0.9					11
Loamy Slope 10-14" (UM) 1	T		11		6		5	2	24	T		3		3		0.4	0.3	8
2			6		2		8		16			3		0.2		0.9		6
3	T		7		2		9		18	T		5		2		2		8

[1]Due to rounding, totals may differ from the sum of values in a line.

[2]T < 1% for shrub cover and T < 100/ac for shrub density.

Our transect data show these Claypan sites are in a deteriorated ecological condition. No bluebunch wheatgrass occurs on these four transects and the frequency of needlegrass is much lower than the frequencies of the three increaser species. The SCS condition estimate was the same for all three MM transects even though shrub cover is higher and grass frequencies are lower on the second transect. Most of the shrubs on these sites are mature or decadent with seedlings and young plants making up less than 10% of the population.

According to the SVIM survey results, the Loamy 10-12" p.z. Range Site in the Mahala pastures is in "good" condition. It covers 18% of the MM pasture and 23% of the UM pasture. The SCS estimated that range condition on both of our transects on this range site in the MM pasture is "fair". In the UM pasture, vegetation on our first transect of this range site was estimated to be in "good" condition, while vegetation on the third was estimated to be in "fair" condition. The second transect is in a "transition" area where the Loamy 10-12" p.z. Range Site vegetation graded into the vegetation of another range site and a condition rating could not be assigned.

The potential plant community of the Loamy 10-12" p.z. Range Site is dominated by bluebunch wheatgrass and big sagebrush with Thurber needlegrass and Nevada bluegrass as important associated species. Big sagebrush, rabbitbrush, bottlebrush squirreltail, and Sandberg bluegrass increase as condition on this site deteriorates according to the SCS range site description.

Data from our Loamy 10-12" p.z. Range Site transects show that vegetation on all are in ecologically deteriorated condition. Frequencies of the four increaser species are high, while the bluebunch wheatgrass and Thurber needlegrass frequencies are low or zero. Vegetation on the first Loamy 10-12" p.z. transect in the UM pasture was the only vegetation that SCS felt was in "good" condition. It had the highest frequency of bluebunch wheatgrass of the five transects and was the only one with a remnant stand of Nevada bluegrass. Bitterbrush, a decreaser species, was also highest on this transect. However, condition is probably declining on this site since 42% of the shrub population is seedling and young plants. The other Loamy 10-12" p.z. transects had less than 15% immature plants in their populations.

On this range site, the bare ground and persistent litter were not significantly different between the two pastures. In the MM pasture, vegetation, pavement, and interspace ground cover were higher while non-persistent litter and coppice were lower than in the UM pasture. The greater amount of coppice in the UM pasture is probably a reflection of higher shrub density while the non-persistent litter value is related to the amount of cheatgrass.

The Loamy Bottom 8-14" p.z. Range Site comprises only 3% of the two Mahala pastures. Vegetation on the Loamy Bottom transect in the MM pasture was estimated to be in "fair" condition by SCS. The SVIM survey results also showed this range site to be in "fair" condition in both pastures.

The potential vegetation of this plant community is dominated by basin wildrye. Basin big sagebrush and rubber rabbitbrush become dominant as the community's ecological condition deteriorates. Also as condition declines, bottlebrush squirreltail will increase in the understory and cheatgrass may invade the site.

The Loamy Bottom area of our MM transect is in a very ecologically deteriorated condition. The basin wildrye is almost gone while the frequency of big sagebrush is high and cheatgrass has invaded the site. Over half of the shrubs in this community are immature plants, an indication that deterioration is continuing. We have not established any transects on this range site in the UM pasture.

In the UM pasture, the Loamy Slope 10-14" p.z. Range Site covers 16% of the area and is in "fair" condition based on the SVIM survey. This range site does not occur in the MM pasture. The SCS estimated the range condition of our three UM transects on this range site to be "fair".

According to the SCS range site description, the potential plant community for the Loamy Slope 10-14" p.z. Range Site is dominated by Idaho fescue, bluebunch wheatgrass, and antelope bitterbrush with big sagebrush usually prevalent enough to dominate the aspect. Big sagebrush and rabbitbrush become dominant as ecological condition deteriorates and cheatgrass is likely to invade the site.

Data from our transects on this site indicate deterioration. Frequencies of the increaser species are high in relation to the low frequencies of Idaho fescue and bluebunch wheatgrass. All three transects have fairly high frequencies of cheatgrass, the invader species. Vegetation on the second Loamy Slope transect was rated highest in condition of the three by the SCS. This transect had the highest frequency of Idaho fescue and of Thurber needlegrass, decreaser species in the potential plant community. Vegetation on the third transect was rated lowest in condition by the SCS. About 20% of the shrubs on this transect are immature while only about 10% are immature on the other two areas sampled. This site also had lower amounts of vegetation, non-persistent litter, and persistent litter than the other two sites and higher amounts of pavement and interspace.

South Forest Service Pasture. Table 2-6 shows frequency and ground cover data from the 1979 and 1981 transects in the South Forest Service (SFS) pasture. Shrub cover and density data for these transects are shown in Table 2-7.

The SVIM survey showed the Steep North Slope 14-18" p.z. Range Site was in "good" condition and covered 3% of the SFS pasture. The SCS estimated "good" range condition for the vegetation on this transect.

The potential community of this range site is dominated by Idaho fescue with big sagebrush and snowberry often prevalent enough to dominate the aspect. Bluebunch wheatgrass is an important associated species in the potential. As ecological condition deteriorates big sagebrush, rabbitbrush and snowberry become dominant with increases in bottlebrush squirreltail and Sandberg bluegrass.

Data from our Steep North Slope 14-18" p.z. transect indicate a very good condition. Frequencies of Idaho fescue and bluebunch wheatgrass are still very high in comparison to frequencies of shrub species. Some deterioration

Table 2-6. Frequency (%) of common plant species and ground cover (%) characteristics on range sites in the Saval Ranch's South Forest Service Pastures (SFS) taken during the 1979 and 1981 field seasons.

Range Site		Shrub Frequency (%)										Grass Frequency (%)											Ground Cover (%)								
		AMUT	ARLO	ARAR	ARTR	CHNA	CHVI	PRVI	PUTR	ROWO	SYOR	AGSP	BRCA	BRTE	ELCI	FEID	HEKI	POCU	POLI	PONE	POSA	SIHY	STTH	VEG	BG	MPL	PL	ROCK	PAVE	CRYP	COP	INTER
Steep North Slope 14-18"		7	0		14	0	13	26	0	4	22	30[2]	0	0	1	58[2]	0	0	0	0	35[2]	0	0	6	30	37	11	14	2	T[1]	25	69
Loamy Slope 14-18"		24	0		37	0	30	0	0	T	22	6	0	T	2	28	43			0	0	2	0	10	29	42	12	2	3	T	36	54
Loamy Slope 10-14"		0	0		26	0	19	0	11	0	31	12	1	52	10	5[2]	14			4	7	22	4	2	26	58	14	T	T	T	28	70
South Slope 14-18"	1	T	0		47	0	9	1	10	0	8	27	9	0	9	0	47			0	8	0	0	12	19	42	7	T	20	0	38	51
	2	T	0		24	0	31	11	0	0	5	10	11	0	13	0	69			0	0	0	0	9	8	57	12	1	13	0	27	64
South Slope 12-14"	1	0	7		18	0	8	0	2	0	0	30	0	66	7	0	T			0	57	40	0	3	11	63	11	3	9	0	17	80
	2	0	0		0	1	2	0	11	0	3	24	0	67[2]	46[2]	0	T			0	0	0	0	4	31	54	6	2	2	0	20	76
	3	0	0		10	2	1	0	0	0	2	11	0	83	56[2]	0	0			0	14	0	0	3	9	82	4	0	2	0	9	88
	4	0	0		3	15	0	0	5	0	0	5	0	61[3]	33	0	0			0	0	0	0	3	20	47	11	14	4	0	37	61
	5	0	0		15	16	0	0	14	35	0	5	0	79[3]	27	0	0			0	0	0	0	3	25	59	12	1	2	0	32	66
Claypan 12-16"	1	0	0	1	0	0	6	0	6	0	0	21	0	92[3]	0	0	0	0	0	0	23	0	0	1	2	78	10	5	4	0	7	91
	2	T		18	0	0	50	0	0	0	2	2	0	0	0	?	0	0	0	0	?	0	0	11	11	46	3	16	10	4	13	77
Mt Ridge	1	0		25[2]	0	0	39	0	0	0	T	22	0	0	0	0	5	22	22	0	37	39	0	12	2	41	T	T	44	T	19	70

[1] T < 1%

[2] 9.8 in x 9.8 in sampling frame used, rather than the standard 19.7 in x 19.7 in frame, due to high frequency.

[3] 4.9 in. x 4.9 in sampling frame used, rather than the standard 19.7 in x 19.7 in frame, due to high frequency.

Table 2-6
(Cont.)

Range Site		Grass Frequencies (%)											Forb Frequencies (%)				Ground Cover (%)								
		AGTR	BRCA	BRTE	CASP	ELCI	FEID	HOBR	MURI	PONE	SIHY	STCO	ASSP	IVAX	LUEW	WYAM	VEG	BG	NPL	PL	ROCK	PAVE	CRYP	COP	INTER
Dry Meadow 10-16"	1	0	0	0	53[3]	0	0	0	3	77	5	0	5	50	0	0	23	4	63	10	T[1]	0	0	-	-
	2	0	0	0	24[3]	0	0	5	1	82	2	0	3	3	0	2[3]	22	10	58	10	0	0	T	-	-
	3	0	0	12	63	12	0	0	0	54	T	0	12	26	0	31[3]	6	2	88	4	0	T	0	-	-
Snow Pocket 14-18"		1	T	0	0	T	3	0	0	0	0	53[2]	0	0	68	0	4	9	85	T	1	T	0	3	93

Range Site		Shrub Frequencies (%)										Grass Frequencies (%)								Ground Cover (%)								
		AMUT	ARTR	CEVE	CHVI	POTR	PRVI	RISP	ROWO	SASP	SYOR	AGSU	AGTR	BRCA	BRTE	ELCI	MESP	POSP	POPR	VEG	BG	NPL	PL	ROCK	PAVE	CRYP	COP	INTER
Aspen Thicket 14-18"		14	0	3	0	48	17	0	0	3	17	0	3	0	0	T	0	0	0									
Non-Riparian Aspen	1	10	7	0	3	21	5	8	21	0	0	13	10	27	18	23	0	6	19	4	9	75	11	2	0	0	15	81
	2	17	0	0	0	25	48	5	11	0	49	0	37	27	0	8	T	0	0	8	6	64	21	T	T	0	23	69
	3	15	3	0	2	17	14	0	24	0	57	0	27	0	0	5	5	29	0	7	9	70	13	T	T	0	15	78
	4	35	1	0	0	16	22	9	10	0	35	0	0	0	0	3	0	10	0	2	9	78	9	2	0	T	11	87
Riparian Aspen	1	0	11	0	1	4	13	4	19	0	3	16	7	20	5[3]	6	0	0	63	4	8	73	9	T	5	1	33	63
	2	0	2	0	0	15	46	0	6	0	13	0	0	0	42[3]	13	4	0	0	4	15	65	14	T	1	0	6	90

[1] T < 1%.

[2] 9.8 in x 9.8 in sampling frame used, rather than the standard 19.7 in x 19.7 in frame, due to high frequency.

[3] 4.9 in x 4.9 in sampling frame used, rather than the standard 19.7 in x 19.7 in frame, due to high frequency.

Table 2-7. Live cover (%) and density (1000's/ac) of common shrub species on range sites in the Saval Ranch's South Forest Service pasture taken during the 1981 field season.

Range Site		Live Shrub Cover (%)													Shrub Density (1000's/acre)											
		AMUT	ARAR	ARLO	ARTR	CHNA	CHVI	POTR	PRVI	PUTR	RISP	ROWO	SASP	SYOR	TOTAL[2]	AMUT	ARAR	ARLO	ARTR	CHNA	CHVI	POTR	PRVI	PUTR	RISP	ROWO	SASP	SYOR	TOTAL[2]
Steep North Slope 14-18"		3	0	0	7	0	1	0	3	0	T[1]	0	0	5	20	1	0	0	2	0	2	0	7	0	0.4	0	0	2	16
Loamy Slope 14-18"		15	0	0	8	0	3	0	0	0	2	T	0	3	33	2	0	0	2	0	2	0	0	0	0.7	0.1	0	2	10
Loamy Slope 10-14"		0	0	0	9	0	4	0	0	4	0	0	0	27	44	0	0	0	2	0	2	0	0	0.8	0	0	0	2	7
South Slope 14-18"	1	T	0	0	20	0	T	0	T	4	0	0	0	1	26	0	0	0	5	0	0.7	0	0.6	0.4	0	0	0	0.5	7
	2	0	0	0	10	0	4	0	1	0	0	0	0	2	17	T[1]	0	0	2	0	4	0	2	0	0	0	0	0.3	8
South Slope 12-14"	1	0	0	T	12	0	T	0	0	4	0	0	0	0	17	0	0	0	3	0	0.7	0	0	T	0	0	0	T	7
	2	0	0	0	0	T	0	0	0	5	0	0	0	3	8	0	0	0	0	2	0	0	0	1	0	0	0	0.4	2
	3	0	0	0	4	0	0	0	0	0	0	0	0	T	4	0	0	0	1	0	T	0	0	0	0	0	0	T	1
	4	0	0	0	0	26	0	0	0	5	0	3	0	0	34	0	0	0	T	1	0	0	0	0.5	0	6	0	0	9
	5	0	0	0	16	9	0	0	0	8	0	0	0	0	33	0	0	0	1	1	0	0	0	0.7	0	0	0	0	3
Mt. Ridge 14-18"		0	10	0	0	0	5	0	0	0	0	0	0	0	17	0	10	0	0	0	7	0	0	0	0	0	0	T	20
Claypan 12-16"	1	T	1	0	T	0	3	0	0	2	0	0	0	0	6	0	0.2	0	0	0	1	0	0	0.3	0	0	0	0	2
	2	0	2	0	T	0	5	0	0	0	0	0	0	T	9	0.1	2	0	1	0	5	0	0	0	0	0	0	0.1	12
Non-Riparian Aspen	1	5	0	0	3	0	T	46	0	0	T	15	0	3	72	0.3	0	0	0.6	0	0.3	2	0.8	0	0.2	9	0	1	15
	2	21	0	0	0	0	0	47	34	0	2	2	0	10	116	3	0	0	0	0	0	4	8	0	T	0.8	0	5	20
	3	T	0	0	T	0	T	64	1	0	0	2	0	18	88	1	0	0	0.4	0	0.2	2	3	T	0.1	2	0	5	13
	4	34	0	0	T	0	0	62	6	0	4	2	0	8	117	3	0	0	0.1	0	T	2	3	T	0.8	0.8	0	4	14
Riparian Aspen	1	T	0	0	4	0	0	10	8	0	5	7	23	T	57	T	0	0	2	0	T	2	2	0	0.6	4	0.8	T	12
	2	2	0	0	0	0	0	68	31	0	0	T	0	5	105	T	0	0	1	0	0	2	7	0	0	0.7	0	1	12

[1] T < 1% for shrub cover or T <100/ac for shrub density.

[2] Due to rounding, total values may differ from the sum of the line values.

The low frequency of mountain brome, basin wildrye and antelope bitterbrush on our two transects indicate site deterioration. The SCS considered the vegetation condition on these two sites to be very close (low "good"). Bitterbrush (a decreaser species) still occurs on the first transect but not on the second, while the frequency of rabbitbrush (an increaser species) is much lower on the first than on the second transect. Also, bluebunch wheatgrass is a more frequent species on the first than on the second transect. The first transect had about 20% young plants and 15% decadent shrubs. Mature plants made up over half the shrub population on both transects.

The South Slope 12-14" p.z. Range Site covers 17% of the SCS pasture and is in "fair" condition based on the SVIM survey. The SCS estimated that our transects 2 and 3 on this range site were in "good" condition areas and transects 4 and 5 were in "fair" condition areas. Vegetation on the first transect could not be given a condition estimate since it is in a transition zone between range sites.

Potential vegetation on the South Slope 12-14" p.z. Range Site is described as dominated by bluebunch wheatgrass with big sagebrush prevalent enough to dominate the aspect. Antelope bitterbrush and basin wildrye are also important species in this plant community. Big sagebrush and rabbitbrush become dominant, and cheatgrass is likely to invade, as ecological condition deteriorates.

Our two transects in "good" range condition areas on this range site have higher bluebunch wheatgrass and basin wildrye frequencies and lower rabbitbrush frequencies than our two in fair condition areas. All four areas have been heavily invaded by cheatgrass. Total shrub cover is still low on the "good" condition areas, but is over 30% on both the "fair" condition areas. The fourth transect, which was estimated to be in the lowest condition area, had the highest percentage (60%) of immature plants in the shrub overstory. On the other transects, immature plants made up 20% or less of the total population.

In the SFS pasture, the Claypan 12-16" p.z. Range Site covers about 3% of the area and is in "fair" condition based on the SVIM survey results. One of our transects on this range site was considered to be in a good condition area by the SCS. The other transect appears to be in an old burn area and could not be given a condition estimate.

The potential plant community on this Claypan Range Site is dominated by Idaho fescue, bluebunch wheatgrass, and dwarf sagebrush. Dwarf sagebrush and rabbitbrush become dominant and squirreltail and Sandberg bluegrass increase as the ecological condition deteriorates.

Our transect data from the "good" condition Claypan site needs to be verified by resampling the frequency of both Idaho fescue and Sandberg bluegrass. From visual observation of the site, Idaho fescue is still a more frequent species than the bluegrass. Site deterioration has occurred as indicated by the high frequency of rabbitbrush found on this transect. Thirty percent of the shrubs are young plants which, if they reach maturity, will further the ecological decline of this site.

of the community has occurred as shown by the rather high frequencies of Sandberg bluegrass and rabbitbrush. More deterioration is likely if the young shrubs (30% of the population) in the community reach maturity and become more competitive.

The Loamy Slope 14-18" p.z. Range Site covers 15% of the SFS pasture and is in "fair" condition according to the SVIM survey results. The SCS estimated "good" range condition of the vegetation on our transect on this area.

The potential vegetation community for the Loamy Slope 14-18" p.z. Range Site is presently described as dominated by mountain brome with lesser, but approximately equal, amounts of slender wheatgrass, bearded wheatgrass, and Idaho fescue. The aspect of the site is dominated by a variety of shrubs and trees. Presently, spike fescue is listed as a fairly minor species in the potential community. SCS is considering changing the range site description to show spike fescue with importance equal to slender wheatgrass, bearded wheatgrass, and Idaho fescue.

Sampling results from our Loamy Slope 14-18" p.z. transect suggest that the area is ecologically deteriorated from the potential but is still in fairly good condition. No mountain brome was found on the site but the frequencies of Idaho fescue and spike fescue are still good in relation to the frequencies of the various shrub species. Also, the frequency of bottlebrush squirreltail (an increaser species) is still quite low. About 70% of the shrubs are mature plants. Immature and decadent plants each make up about 15% of the total shrub population.

Four percent of the SFS pasture is covered by "fair" condition Loamy Slope 10-14" p.z. Range Site vegetation according to the SVIM survey. The SCS estimated "fair" vegetation condition on our transect representing this range site.

Our transect data show the vegetation condition of this site is similar to the vegetation condition on three Loamy Slope 10-14" p.z. transects in the UM pasture. Frequencies of increaser species (sagebrush, rabbitbrush, and bottlebrush squirreltail) on this site are higher than the frequencies of decreaser species (Idaho fescue and bluebunch wheatgrass) and, like the 3 UM transects, the frequency of cheatgrass is fairly high. This SFS site has a ratio of about 3 mature plants to each decadent plant. The mature-decadent ratio in the UM pasture was slightly less than 2:1. Immature plants in both pastures make up about 15% of the shrub population on this range site.

According to the SVIM survey, a total of 13% of the SFS pasture is South Slope 14-18" p.z. Range Site with 7% in "good" condition and 6% in "fair" condition. Our two transects are in the SVIM survey's "fair" condition area but the SCS condition estimate was "good" for both.

The potential vegetation community for this range site is described as dominated by mountain brome, basin wildrye, and antelope bitterbrush with bluebunch wheatgrass an important associated species. Big sagebrush and rabbitbrush become dominant as ecological condition deteriorates. Also, cheatgrass is likely to invade as condition declines.

The Mt. Ridge 14-18" p.z. Range Site is in "good" condition and covers 27% of the SFS pasture according to the SVIM survey. The SCS estimated our Mt. Ridge transect to be in a high "fair" condition area.

Potential vegetation on the Mt. Ridge 14-18" p.z. Range Site is dominated by Idaho fescue, low sagebrush, and black sagebrush. Bluebunch wheatgrass, bottlebrush squirreltail, Sandberg bluegrass, and Cusick bluegrass are some of the important grass species. The dwarf sagebrush and small rabbitbrush become dominant with increases in Sandberg bluegrass as the ecological condition deteriorates from the potential.

Our Mt. Ridge transect still has bluebunch wheatgrass and Cusick bluegrass but their frequencies are lower than the frequencies of increaser species (Sandberg bluegrass and squirreltail), an indication of some site deterioration. The high frequencies of low sagebrush and rabbitbrush also show this site is ecologically deteriorated. The ratio of seedlings : young : mature : decadent plants in this shrub community was 0 : 4 : 4 : 1. Pavement ground cover was higher on this range site than on the other range sites in the SFS pasture.

The Dry Meadow 10-16" p.z. Range Site covers only a trace of the SFS pasture and was not typed out or sampled by the SVIM survey. When our transect sites were visited by the SCS, heavy grazing prevented a condition estimate.

The potential plant community on this range site is dominated by Nevada bluegrass, alpine timothy, and meadow sedges. As ecological condition deteriorates, sedges and rushes become dominant and brush species (i.e., sagewort, silver sagebrush, and rabbitbrush) increase in the overstory. Kentucky bluegrass and foxtail barley are invader species.

Our three transects on the Dry Meadow 10-16" p.z. Range Site suggest a fairly "good" condition. Nevada bluegrass frequencies are still high and no shrubs occur on these transects.

Two percent of the SFS pasture is Snow Pocket 14-18" p.z. Range Site in "good" condition, according to the SVIM survey. Our snow pocket transect was estimated to be in a high "fair" condition area by the SCS.

The potential plant community of this range site is dominated by tailcup lupine and Letterman needlegrass. As ecological condition declines, lupine increases and will eventually dominate the site. Letterman needlegrass composition declines as Columbia needlegrass and bottlebrush squirreltail increase in importance. On lower condition sites, rabbitbrush often invades the plant community.

Our snowpocket transect data shows this site is in an ecologically deteriorated condition. Lupine dominates the site and Columbia needlegrass has replaced the Letterman needlegrass. No rabbitbrush has invaded, so the ecological deterioration has not reached the lowest possible level.

The Aspen Thicket 14-18" p.z. Range Site covers 9% of the SFS pasture and is in "good" condition according to the SVIM survey. The SCS estimated our Aspen Thicket transect to be in a high "fair" condition area. The potential plant community on this range site is dominated by low-growing "snowbank" aspen. Mountain brome, slender wheatgrass, and snowberry are some of the important understory species. As ecological condition deteriorates, the aspen overstory is thinned out and permanent openings in the canopy are created. Snowberry, big sagebrush, other shrubs, grasses, and forbs may increase in the understory with deterioration, and eventually become dominant. Kentucky bluegrass is likely to invade this site.

Some deterioration has occurred on our Aspen Thicket transect area. The frequency of aspen is still high but snowberry, serviceberry, and chokecherry have become fairly frequent shrub species.

In the SFS pasture, Riparian Aspen Woodland and Non-Riparian Aspen Woodland each cover about 2% of the area according to the SVIM survey. Under the SCS range site system, woodland vegetation is given a Forage Value Rating (FVR) rather than a condition class rating as are other range sites. The FVR is based on the percent by weight of preferred and desirable species for cattle in the understory (up to 4.5 feet in height).

The species found on our transects that are listed as "preferred" are bearded wheatgrass, slender wheatgrass, mountain brome, oniongrass, and bluegrass. The "desirable" species are basin wildrye, serviceberry, low rabbitbrush, quaking aspen, currant, Wood rose, and mountain snowberry. Kentucky bluegrass and cheatgrass brome are invader species and are not considered in this rating system. Data from our six aspen woodland sites suggest that the fourth non-riparian and the second riparian transect would probably have the lowest FVR. Few of the "preferred" species occur on these transects, and the frequencies of those that do are fairly low.

Wet Meadow Range Site

Trend transects on the Wet Meadow Range Site were established at 11 locations in 1981. Sampling of an additional six to eight locations was prevented because of cattle grazing in the Jim and Mahala Creek drainages of the South Forest Service pasture before the deferred treatment was scheduled for use.

Transects on the BLM portion of the Saval Allotment are located along Jim and Mahala Creeks and ephemeral channels adjacent to stock ponds. One site is on a tributary to Gance Creek in the West Darling Seeding. This relatively large meadow is probably the main source of wet meadow species found in the diet of cattle grazing this seeding.

The threatened species, arching pussytoes, was found on three of the meadows sampled. Previously this species was observed only on the Tremewan hay meadow. The presence of this species will enable us to evaluate its response to deferred and rest-rotation grazing management.

The meadow in Middle Mahala Creek pasture supports vegetation that is much different than that found on other meadows sampled over the past three years. The dominant grass is a rhizomatous wheatgrass, either western or thickspike

wheatgrass. Saltgrass also is an important part of the composition and indicates some level of soil salinity. Soil salinity may favor saltgrass and the rhizomatous wheatgrass over Nevada bluegrass which is the dominant species on other meadows at comparable elevations. The development of saline soil on this site may be due to the meandering, untrenched channel that suggests an old land surface. Over time, water carrying dissolved salts from the uplands was the source of ground water on this site. As water moved from the channel into the root zone of plants then upward toward the surface, salts were deposited and concentrated near the surface. On meadows with entrenched channels, precipitation moves salts away from the soil surface and toward the channel in percolating ground water. Thus any salts in the profile are washed away. An enclosure has been built on this site so that vegetative and hydrological characteristics can be evaluated under rest-rotation grazing management and protection from grazing.

One study meadow on the Forest Service allotment was on Mahala Creek just above the BLM boundary. A portion of this site is very wet due to a large spring or springs. The drier portion of this meadow exhibits the worst range condition of all meadows sampled since 1978. While some Kentucky bluegrass is present, slender wheatgrass appears to dominate the site. The dominance of this species, and the invasion of basin big sagebrush, suggests that the site is becoming more xeric. In addition, an unpalatable and weedy broadleaf species, elk thistle, is the dominant forb (frequency of 50%).

The meadow site on Jim Creek above the FS boundary is still dominated by Kentucky bluebrass and redtop. However, elk thistle with a frequency of 12% indicates the community is open to the establishment of this weed species as well as to an increase of iris and species of cinquefoil, and invasion by bull thistle. The higher elevation meadows on Jim Creek are in better condition and are dominated by Kentucky bluegrass, redtop, sedge, and a variety of forbs. High condition is indicated by the presence of tufted hairgrass on these meadows but not in the frequency sample. However, a weedy, herbaceous species of sagebrush, sagewort, on one study site indicates less than stable range condition at that location.

Utilization

1981 Objective:

Estimate species utilization on the major range sites in Lower Sheep Creek (LSC), Upper Sheep Creek (USC), North Forest Service (NFS), and South Forest (SFS) pastures at the end of the respective 1981 grazing periods.

1981 Accomplishments:

Grazing use on the various range sites was estimated by utilization classes described in the "Key Forage Plant Method" in BLM Manual 4411.11B7c. These estimations were made to identify cattle preferences between range sites, changes in species and range site preferences over the summer grazing season, and differences in use between the 1980 and 1981 grazing seasons on the Forest Service pastures.

Since the LSC pasture was scheduled to be plowed and seeded in fall, 1981, it was grazed heavily in spring, 1981, to use the available forage before treatment. This also provided an opportunity to rest the other BLM pastures normally grazed during early spring.

Overall use on the LSC pasture was 55 to 60 percent. All of the old forage accumulated during 1980 when the pasture was rested was used, in addition to early spring growth in 1981. Use of species such as sedge, rush, bluegrass, and wheatgrass on Loamy Bottom and Wet Meadow Range Sites was severe (81-100%). Utilization of species on the Loamy and Claypan Range Sites was heavy (61-80%) on Webber ricegrass and Thurber needlegrass and moderate (41-60%) on Sandberg bluegrass, bottlebrush squirreltail, and basin wildrye. The cattle were moved to the USC pasture in time for grasses to regrow and set seed on the LSC pasture.

Cattle grazed the USC pasture for approximately 2 weeks in late spring. Utilization of vegetation was slight (0-20%) to light (21-40%) on all the range sites sampled (Table 2-8) with the Wet Meadow, Loamy Bottom, and Loamy 8-10" sites receiving the most use. Two of the most preferred forage species (Nevada bluegrass and sedge) are common on the Wet Meadow and Loamy Bottom Range Sites and received considerable cattle use (Table 2-9). The Loamy 8-10" Range Site is mainly along the lower or eastern part of the USC pasture. Since the cattle were turned in there, use was heavier in this part of the pasture. If the grazing period had been longer, more cattle would probably have drifted west, up the pasture, and distributed use over the higher elevation range sites. Topography in this pasture is fairly gentle and would have had little effect on cattle distribution.

During the first few weeks the cattle were on the NFS pasture, the Wet Meadow and Aspen Woodland sites received the heaviest use (Table 2-10). Bluegrasses and sedges (common species on these range sites) were the most preferred species during this time (Table 2-11).

At the end of the grazing period on the NFS pasture, the Wet Meadow, Aspen Woodland, and Aspen Thicket Range Sites had all been severely utilized (81-100%). The Dry Meadow, South Slope 14-18", North Slope 14-18", and Loamy

Table 2-8. Vegetation utilization by cattle on range sites on the Upper Sheep Creek (USC) pasture of the Saval Ranch for the 1981 Spring grazing season (mid-May to early June).

Range Site	Sample Size	Percent of Plots Unused	Average Util. on Used plots[1]
Loamy 8-10"	2	0	2+
Loamy 10-12"	4	0	2-
Loamy Slope 10-14"	4	0	1+
Loamy Bottom 8-14"	2	0	2+
Claypan 10-12"	6	17	2-
Claypan 12-16"	2	50	1
Wet Meadow 8-16"	4	0	2+

[1]See Table 2-9 for key to utilization classes.

Table 2-9. Vegetation utilization by cattle, abundance of common grass species, and the range sites on which they occurred during spring of 1981 in the Upper Sheep Creek (USC) pasture of the Saval Ranch.

Species	Ave. Abund.[1]	Ave. Util.[2]	Range sites sampled[3]
Nevada bluegrass	3	3-	1,2
Sedge spp.	3	3	1,2
Rush spp.	2	1+	1,2
Mat muhly	2	2	1,2
Webber ricegrass and Thurber needlegrass	2	3-	4,6,7
Idaho fescue	2	2-	3,4,6
Basin wildrye	2	1	2,3,6,7
Bluebunch wheatgrass	2	2-	3,4,6,7
Sandberg bluegrass	3	1+	3,4,5,6,7
Bottlebrush squirreltail	3	1+	1,3,4,5,6,7

[1] Abundance Classes

1 = Infrequent

2 = Occasional

3 = Common

4 = Abundant

[2] Utilization Classes

0 = No use = 0%

1 = Slight = 1-20%

2 = Light = 21-40%

3 = Moderate = 41-60%

4 = Heavy = 61-80%

5 = Severe = 81-100%

[3] Range Sites

1 = Loamy Bottom 8-14" p.z.

2 = Wet Meadow 8-16" p.z.

3 = Loamy Slope 10-14" p.z.

4 = Loamy 10-12" p.z.

5 = Claypan 12-16" p.z.

6 = Claypan 10-12" p.z.

7 = Loamy 8-10" p.z.

Table 2-10. Vegetation utilization by cattle on range sites on the Saval Ranch's Forest Service pastures for the 1981 summer grazing season.

Range Site	North Forest Service (NFS) (Late June)			North Forest Service (NFS) (August)			South Forest Service (SFS) (October)		
	Sample Size	% of Plots Unused	Util. on Used Plots[1]	Sample Size	% of Plots Unused	Util. on Used Plots[1]	Sample Size	% of Plots Unused	Util. on Used Plots[1]
South Slope 12-14"	-	-	-	3	0	2+	9	0	1+
South Slope 14-18"	1	0	3-	2	0	4	2	0	2+
Steep North Slope 14-18"	1	0	1-	2	0	2	3	33	1-
North Slope 14-18"	1	0	2-	2	0	4-	-	-	-
Loamy Slope 10-14"	-	-	-	3	0	4-	1	0	4-
Loamy Slope 14-18"	1	0	2	2	0	3+	6	17	1+
Snow Pocket	-	-	-	-	-	-	2	50	2+
Aspen Thicket	1	0	2	1	0	5	2	50	1
Aspen Woodland	2	0	4	4	0	5	7	0	3+
Claypan 12-16"	1	100	-	5	60	2-	8	0	1+
Mt. Ridge 14-18"	-	-	-	2	0	2	2	100	-
Dry Meadow	-	-	-	3	0	4+	3	0	5
Wet Meadow	6	0	4+	6	0	5	5	0	5

[1] See 2-12 for key to utilization classes.

Table 2-11. Vegetation utilization by cattle, abundance of common grass species and antelope bitterbrush, and range sites on which they occurred during the summer of 1981 in the Forest Service pastures of the Saval Ranch.

Species	North Forest Service (NFS) Late June		North Forest Service (NFS) August		South Forest Service (SFS) October		Range sites where species were sampled[1]
	Abundance[1]	Utilization[1]	Abundance[1]	Utilization[1]	Abundance[1]	Utilization[1]	
Kentucky & Nevada bluegrass	3	4	3	5	3	4+	1,3,4,12
Sedge spp.	3	4-	3	4+	3	4	1,3,4
Rush spp.	3	3-	3	3+	2	3+	1,3
Mat muhly	-	-	2-	3-	-	-	4
Spike fescue	2	3	2	3+	2	1+	2,5,6,7,8,9,10
Idaho fescue	3	2-	3	3	3	1-	2,5,6,7,8,9,10,11
Basin wildrye	3	1+	3	3	3	2-	1,2,4,5,6,7,8,9,10,11,12
Bluebunch wheatgrass	3	1+	3	2+	3	1+	2,5,6,7,8,9,10,11
Slender wheatgrass	1	0	1	5	2	2	1,2,12
Mountain brome	-	-	2	1	2	0	1,2,5,8
Sandberg bluegrass	4	0	4	1	3	0	5,7,8,9,10
Bottlebrush squirreltail	3	0	3	1	3	1-	5,7,9,10
Antelope bitterbrush	-	-	2	3	2	3	2,5,7,8,9

[1]See Table 2-12 for key to abundance, utilization and range sites.

Table 2-12. Key for abunance class, utilization class and range site symbols used in Tables 2-10, 2-11, and 2-13.

Abundance Class	Utilization Class	Range Site
1 = Infrequent	0 = No use = 0%	1 = Aspen Thicket 14-18" p.z.
2 = Occasional	1 = Slight = 1-20%	2 = Loamy Slope 14-18" p.z.
3 = Common	2 = Light = 21-40%	3 = Wet Meadow 8-16" p.z.
4 = Abundant	3 = Moderate = 41-60%	4 = Dry Meadow 10-16" p.z.
	4 = Heavy = 61-80%	5 = South Slope 12-14" p.z.
	5 = Severe = 81-100%	6 = Steep North Slope 14-18" p.z.
		7 = Loamy Slope 10-14" p.z.
		8 = South Slope 14-18" p.z.
		9 = Claypan 12-16" p.z.
		10 = Mountain Ridge 14-18" p.z.
		11 = North Slope 14-18" p.z.
		12 = Aspen Woodland

Slope 10-14" Range Sites had received heavy (61-80%) use, while use on the Loamy Slope 14-18" Range Site was moderate (41-60%). Only 2 of the 35 sites sampled for utilization in the NFS were unused. Both of the unused sites were Claypan 12-16" Range Sites on very steep slopes.

Preferred species during the NFS grazing period were Kentucky and Nevada bluegrass, slender wheatgrass, and sedges. All these species are found on Wet Meadow, Aspen Woodland, and/or Aspen Thicket Range Sites. The least preferred species during this period were mountain brome, Sandberg bluegrass, and bottlebrush squirreltail. These three species occur on a variety of range sites which overall may be heavily utilized (e.g., Loamy Slope 10-14") or only lightly used (e.g., Mountain Ridge 14-18").

When the SFS pasture was grazed during late summer, the Wet and Dry Meadow sites received severe use while the Aspen Woodland and Aspen Thicket sites received moderate and slight use, respectively. Use in the SFS on most of the other range sites was lighter than it had been on the same range sites in the NFS. The Loamy Slope 10-14" Range Site received the same degree of use in both pastures.

Preferred species in the SFS during late summer were those found on Wet and Dry Meadows and Aspen Woodland sites: Kentucky and Nevada bluegrasses and sedges. Mountain brome, Sandberg bluegrass, and bottlebrush squirreltail were again the least preferred forage species.

Use on most grass species sampled was lower in the SFS than it had been in the NFS. Last year, use on bluebunch wheatgrass and Idaho fescue was higher in late than in early summer (Stager and Eckert, 1980 Progress Report). This increase in use was not observed this year, probably because no fall greenup occurred in 1981 as in 1980.

Antelope bitterbrush received moderate use (41-60%) in both pastures. Cattle do not normally use bitterbrush until late summer or fall. Use of bitterbrush in the early summer may be a reflection of the heavy utilization of the preferred herbaceous species. A lack of preferred herbaceous species may have caused an earlier than normal switch to bitterbrush.

Table 2-13 compares grazing use in 1980 and 1981 on trend plots in the two Forest Service pastures. In the SFS pasture, little difference in use on these plots was found between early (1980) and late (1981) grazing. However, in the NFS pasture, use on most sites was higher in 1981 when grazed early than in 1980 when grazed late. Whether these pastures are grazed early or late, the heaviest use is always found on the riparian areas.

Table 2-13. Summary of 1980 and 1981 vegetation utilization by cattle on trend plots in the North and South Forest Service (NFS and SFS) pastures of the Saval Ranch.

	NFS - Utilization (%)[1]			SFS - Utilization (%)[1]		
Range Site	Trend Plot	1980	1981	Trend Plot	1980	1981
South Slope 12-14"	80-34	1	2-	79- 9	2	1
	80-39	1+	2	81-20	-	1-
				81-21	-	1-
				81-22	2	2
				81-26	-	2
South Slope 14-18"	80-30	3	4	81-16	3-	2-
	80-32	3	4+	81-17	-	3-
	80-36	2+	4-			
Loamy Slope 10-14"	79-10	3-	3+	79-13	-	4-
	79-14	2+	4-			
Loamy Slope 14-18"	79-23	3-	3-	81-23	-	1
	80-38	2	4			
Steep North Slope	79-25	1+	1-	79-24	0	1-
	79-28	2	3			
Mt. Ridge	79- 3	2	1-	79- 5	1	0
	79- 6	2	3+			
	80-31	0	0			
Claypan 12-16"	79- 4	0	0	81-18	-	2+
	80-28	0	0	81-25	-	1
	80-29	1+	2+			
	80-33	0	0			
Snowbank				79-27	2	2+
Aspen Thicket	79-26	1-	4	79-20	0	0
Non-Riparian Aspen	80-37	2+	5	79-21	3+	3+
				81-24	-	4
				81-15	-	1
Riparian Aspen[4]	80-35	2+	5+	79-22	3-	3
				81-13	4+	4+
Dry Meadow				81-11	-	5+
				81-12	-	5+
				81-14	3	4+
Wet Meadow	Upper Stump	4+	5	Upper Gance Cr.	4+	4+
	Lower Stump	4+	5+	Upper Gance Cr.	5+	5
	Mahoney Sp.	4-	5-	Gance Creek	5	5
	California Cr.	3	5-	Mahala Creek	5	5
	Sheep Creek	4	5	Mahala Creek	5+	5+

[1]See Table 2-12 for key to utilization classes.

Production

1981 Objective:

To measure production of herbaceous species on important range sites in crested wheatgrass seedings, BLM pastures, and USFS pastures.

1981 Accomplishments:

In the 1981 field season eight production sites were established and clipped periodically during the spring and early summer. Our goal was to sample each production site four times during the growing season. Due to weather and various other problems, some sites were sampled only two or three times.

In fall, 1981, soil moisture blocks were installed at each production site and three additional production sites with soil moisture blocks were also established. In the future, these moisture blocks will be used to relate production to the soil moisture available on each site during the growing season.

Production data were collected by clipping and weighing herbage of individual species from 10 to 20 circular plots on each sampling site. Plot size was 10.8 ft square on upland sites and 1.1 ft square on the Wet and Dry Meadow sites. Samples were air dried and reweighed to provide air-dry production/acre. Phenologic stage was recorded for each species sampled. Future sampling will be a combination of clipping and estimating for species production and will include shrub production.

The SVIM survey estimated production on the Saval Ranch crested wheatgrass seedings at 826 lb/ac (adjusted to peak production at seed-ripe and median precipitation year). Our highest level of production from these seedings (231 lb/ac) was on the fourth sampling date, June 23 (Table 2-14). Peak production on this site probably occurred after this date. Crested wheatgrass was still in "bloom" stage on June 23 and peak production does not occur until seed ripe. Using the BLM phenology adjustment factor on our data, peak production this year may have been about 337 lb/ac. This figure would still be low since it was not corrected for this season's below normal precipitation at this elevation (higher elevation sites received closer to normal amounts of precipitation).

According to the SCS description for the Loamy 8-10" p.z. Range Site, potential herbaceous production is 360 to 480 lb/ac in a normal precipitation year and 240 to 320 lb/ac in a poor precipitation year. In the Lower Mahala pasture where our Loamy 8-10" p.z. production site is located, the SVIM survey estimated herbaceous production for this range site at 239 lb/ac (corrected for phenology and precipitation).

Our Loamy 8-10" production site was abandoned after the second sampling period. The site was in a sheep driveway and sheep grazing in early June precluded continued sampling. A replacement site has since been located well away from the driveway.

Using the data from our last sampling period on May 21 and BLM phenology adjustment factors, we can project that peak production on this site would have been about 188 lb/ac (not including an adjustment for the below normal

Table 2-14. 1981 Herbaceous production (lb/ac, air dry) on 8 range sites on the Saval Ranch taken at various dates during the growing season.

Range site and sampling date	Grasses	Forbs	Total
Crested Wheatgrass			
4-23-81	106	T[1]	106
5-11-81	165	2	167
6-13-81	187	1	188
6-2,3,-81	231	0	231
Loamy 8-10" p.z.			
4-30-81	45	33	78
5-21-81	33	61	94
-	-	-	-
-	-	-	-
Claypan 10-12" p.z.			
4-28-81	66	53	119
5-22-81	60	31	90
6-15-81	60	33	93
7- 6-81	42	7	49
Loamy Slope 10-14" p.z.			
5- 6-81	100	31	131
-	-	-	-
6-17, 18-81	97	22	119
7- 8-81	91	7	98
Dry Meadow 10-16" p.z.			
5- 7, 8-81	677	T	677
5-27, 28-81	678	46	714
6-19, 22-81	573	113	687
7- 7-81	531	95	627
Wet Meadow 8-16" p.z.			
6- 8, 9-81	3064	165	3229
6-29, 30-81	2258	359	2616
7-14, 15, 16-81	2557	269	2826
South Slope 12-14" p.z.			
5-12, 13-81	205	161	366
6- 3, 4, 5-81	533	151	684
6-24, 25, 26-81	385	164	549
7-13, 14-81	347	88	435
Steep North Slope 14-18" p.z.			
6- 9, 10, 11-81	110	297	407
7- 1, 2-81	85	499	584
7-20, 21, 22-81	77	385	462

[1] T < 1 lb/ac.

precipitation at this low elevation site). From visual observation, peak production probably occurred in early to mid-June. Bottlebrush squirreltail, Sandberg bluegrass, and phlox were the most productive species on this site.

Potential herbaceous production on the Claypan 10-12" p.z. Range Site is 360 to 480 lb/ac in a poor precipitation year according to the SCS range site description. Herbaceous production on this range site in the Mahala pastures is 205 lb/ac based on the SVIM survey clipping results.

The highest herbaceous production found on our Claypan 10-12" p.z. site this year was 119 lb/ac on our first sampling date (April 28, 1981). Based on phenology, peak production should not have occurred until late May or early June. Our sampling date showed that yield declined slightly between late April and late May, remained at about 90 lb/ac between late May and mid-June (when production should have peaked), then dropped off to about 50 lb/ac in July. This unusual pattern is probably the result of the poor precipitation year and drying and shattering of leafy tissue. The most productive species were bottlebrush squirreltail, Sandberg bluegrass, phlox, lupine, and aster.

Potential herbaceous production on the Loamy Slope 10-14" p.z. Range Site is 585 to 765 lb/ac in a normal year and 390 to 510 lb/ac in a poor year. The herbaceous production on this range site in the Upper Mahala pasture is 368 lb/ac, according to the SVIM survey.

Peak herbaceous production on our Loamy Slope 10-14" p.z. site should have occurred in mid- to late June based on phenology records. However, the highest production sampled this year was 131 lb/ac in early May. The amount of grass production remained fairly steady from early May to early July, but forb production decreased substantially between mid-June and early July. The bulk of production on this site was from bottlebrush squirreltail, Sandberg bluegrass, cheatgrass, wild onion, penstemon, and fleabane.

The Dry Meadow 10-16" p.z. Range Site has a potential herbaceous production of 1040 to 1300 lb/ac in a normal year and 640 to 800 lb/ac in a poor year according to the SCS range site description. The SVIM survey categorized all the meadow vegetation in the Mahala pastures as "Wet Meadow" Range Sites. Most of the meadow areas in the Mahala pastures occur along intermittent stream channels which are normally "Dry Meadow" Range Sites areas. The SVIM survey estimated production on the meadow sites in the Upper Mahala pasture at 3,555 lb/ac (which is much higher than the potential of either the Wet or Dry Meadow Range Sites).

Peak production on our Dry Meadow sampling site in the Upper Mahala pasture probably occurred between the late May and June sampling dates based on phenology data. Herbaceous production was rather low (627-714 lb/ac) on this site for all four sampling dates. Production on a Dry Meadow Range Site is very dependent on the amount of water in the intermittent streams. Stream flow was very low this year due to the poor winter snowpack and low runoff from a few spring storms. Most of the herbaceous yield on this Dry Meadow site was from Nevada bluegrass, mat muhly, sedge, and poverty sumpweed.

Potential herbaceous production on a Wet Meadow 8-16" p.z. Range Site is 1445 to 1870 lb/ac in a normal year and 850 to 1100 lb/ac in a poor year

according to the SCS range site description. The SVIM survey estimated production on the Gance Creek Wet Meadow Range Sites in the South Forest Service pasture at 4159 lb/ac.

Peak production on our Wet Meadow sampling site probably occurred in early to mid-July based on phenology data. However, our highest production sample was 3229 lb/ac in early June. The most productive herbaceous species on this site were Kentucky bluegrass, sedge, rush, aster, and cinquefoil.

Potential herbaceous production on the South Slope 12-14" p.z. Range Site is 700 to 900 lb/ac in a normal year and 526 to 673 lb/ac in a poor year according to the SCS range site description. The SVIM survey estimated herbaceous production in the area of our sampling site at 493 lb/ac.

Peak production on our sampling site should have occurred in early July this year based on phenology data. Our highest herbaceous production was 684 lb/ac in early June, with lower yields through mid-July. Grasses are the major component of the herbaceous production on this site. The most productive species on the site were bluebunch wheatgrass, Sandberg bluegrass, bottlebrush squirreltail, cheatgrass, lupine, and tapertip hawksbeard.

According to the SCS range site description, the potential herbaceous production on the Steep North Slope 14-18" p.z. Range Site is 680 to 920 lb/ac in a normal year and 476 to 644 lb/ac in a poor year. The SVIM survey estimated herbaceous production on this range site in the SFS pasture at 653 lb/ac.

The highest production we sampled on this range site was 584 lb/ac in early July. Based on phenology, peak production may have occurred soon after this sample. Precipitation at this elevation was probably closer to normal than at the lower elevation sites. Therefore, 584 lb/ac may be a fairly good indication of the peak level of production on this site. The most productive herbaceous species on this site were rose pussytoes, eriogonum, tapertip hawksbeard, and Idaho fescue.

Under the new management system for the Saval Ranch, spring grazing on the Darling Seedings, the Lower Sheep Creek Seeding, and the Lower Mahala pasture will be from April 15 to May 30 with a deferred-rotation system. Based on 1981 phenology data, grazing during this period will precede the peak of production on crested wheatgrass seedings, and Loamy 8-10" p.z., and the Claypan 10-12" p.z. Range Sites in these pastures. This grazing period will include the fastest rates of growth between the early leaf and early bloom stages of phenology for the species found in these pastures.

Grazing use on the Upper and Middle Mahala pastures and the Upper Sheep Creek pasture will be from June 1 to June 30 under a rest-rotation system. This period of grazing will include peak production during June on Claypan 10-12" p.z., Loamy 8-10" p.z., Loamy Slope 10-14" p.z., and Dry Meadow 10-16" p.z. Range Sites.

The Forest Service pastures will be grazed from July 1 to the end of September under a stuttered-deferred system. This grazing period will include peak production on Wet Meadow, South Slope 12-14"p.z., and Steep North Slope 14-18" p.z. Range Sites.

CHAPTER 3

SAGE GROUSE RESEARCH

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1981 Objectives:

1. Document sage grouse movements, distribution and population levels on the entire study area.

2. Document habitats used by sage grouse for seasonal activities on the entire study area.

3. Gather baseline information on sage grouse movements, distribution and population levels around the proposed Sheep Creek seeding.

4. Gather baseline information on habitat utilization by sage grouse in and around the proposed Sheep Creek seeding.

5. Document types and amounts of vegetation that were available, in the Lower Sheep pasture, for sage grouse to use.

1981 Accomplishments:

Surveys on wintering grounds, strutting grounds, brood use areas and harvest were conducted during this period. These are procedures usually conducted by NDOW on a yearly basis in other areas of the state.

One of the major accomplishments during this period was the capture of 48 sage grouse for movement work. There were 16 female grouse in this group. Each of the females was fitted with a radio transmitter to document movement patterns and habitat utilization. Each radioed bird was located periodically throughout the summer. Over 130 telemetry sites were marked for later habitat sampling. Seventy-six of these sites were eventually sampled.

The vegetation types in the Lower Sheep pasture were mapped during this period. Within each of the vegetation types, plant community structure was documented. Also within each location of each type a sage grouse dropping transect was established. Just under 100 miles of transect were completed with significant results.

Approach

Overall Study

Populations and Movements

Three methods were used to achieve a reasonable approximation of sage grouse population levels on the study area. First, all strutting grounds were surveyed at the same time one day per week for a month. The main objective here was to determine the number of adult males, juvenile males and females participating in breeding activities. The period of peak breeding or peak female attendance was also determined from these counts. Thirdly, brood surveys were conducted along standardized routes on the study, to determine grouse production.

In order to determine sage grouse movements, a sample of birds was captured from different locations on the study area. Two established trapping methods were utilized to achieve this objective. First, a stationary cannon net was used on two of the larger strutting grounds. The nets were set up prior to the peak of breeding activity. Even during this time period, this method met with only very limited success.

Most of the birds that were captured were obtained using the night spotlighting technique. In essence this method involves driving roads and adjacent low sagebrush areas after dusk and using a handheld spotlight to locate roosting grouse. Sage grouse have a characteristic eye-shine of silver blue which separates them from rabbits and other larger mammals. After a bird was located it was captured with a long handled net.

All females were fitted with transmitters. Transmitters were affixed to a "Poncho type" transmitter attachment. All males were marked with color-coded patagium wing streamers and a colored, plastic leg band. The color of the wing streamers and plastic leg band identified the strutting ground where individual males were captured. In addition to the above markings, all captured grouse were fitted with individually numbered aluminum leg bands.

Each marked female was located periodically throughout the field season. All grouse were located by aircraft, then relocated by ground vehicle.

Habitat Documentation

Each telemetry location as well as random grouse sightings were marked for vegetation sampling. At each site a macroplot (14.5 feet x 14.5 feet) was established (See 1980 Habitat report for plot diagram). Within each of these macroplots 25 microplots (20 inches x 20 inches) were established. The middle microplot (13) was located on the exact bird location.

Data recorded or each macroplot included -

1. Activity type (nesting, brood, etc.)
2. Exact location
3. Age and sex of bird
4. Height and crown diameter of 10 randomly selected shrubs
5. If a nest site, then height from the ground to the bottom of the canopy of the shrub the nest was under.
6. Crown diameter and height of shrub in number 5.

Data recorded for each microplot included -

1. Ground cover type (bare ground, litter etc.) at each of 4 points.
2. Each plant species in the plot.
3. Total canopy cover (%) for each plant species in the plot.

Information from each plot was recorded on a computer coding form to facilitate analysis (see 1980 Habitat Report for coding format).

Lower Sheep Pasture Study

Population and Movements

The same methods were used in this section as in the previous section.

Habitat Documentation

Sage grouse habitat work in the Lower Sheep pasture occurred in 3 phases. First, vegetation types were mapped on 1:7920 black and white aerial photographs. Ground techniques combined with color infrared photography and LANDSAT imagery were the mapping tools. Plots identical to those described above were used to document each mapped vegetation type.

With each location of each vegetation type a sage grouse dropping transect was established. Each of these dropping transects was 1000 steps (2.5 feet) or 2500 feet in length and just over 3 feet wide. The total area covered by each transect was approximately 7500 square feet or 0.23 acres. Each sage grouse dropping located within this area was counted as well as the distance between droppings.

Results and Discussion

Overall Study

Population and Movements

Wintering Ground Surveys

Sage grouse wintering ground surveys were initiated in December, 1980. During much of this period, snow accumulation at lower portions of the study area varied from a few inches to snow being totally absent over much of the project area. There were similar conditions during the previous years' surveys.

Sage grouse attendance at identified wintering ground was poor at best. Only 3 of the 23 previously identified wintering grounds were found active. The number of birds in attendance at these grounds fluctuated greatly among survey days. Unlike conditions during the winter of 1978-79, when the majority of these grounds were identified, the last two winters have been mild. Sage grouse have reacted to these milder winter conditions by maintaining both smaller group sizes and larger distribution areas.

Sage Grouse Strutting Ground Surveys

There are presently 10 identified strutting grounds on the study area (Figure 3-1). The bulk of the sage grouse population on the study area is located around ground 7 in Middle Mahala pasture.

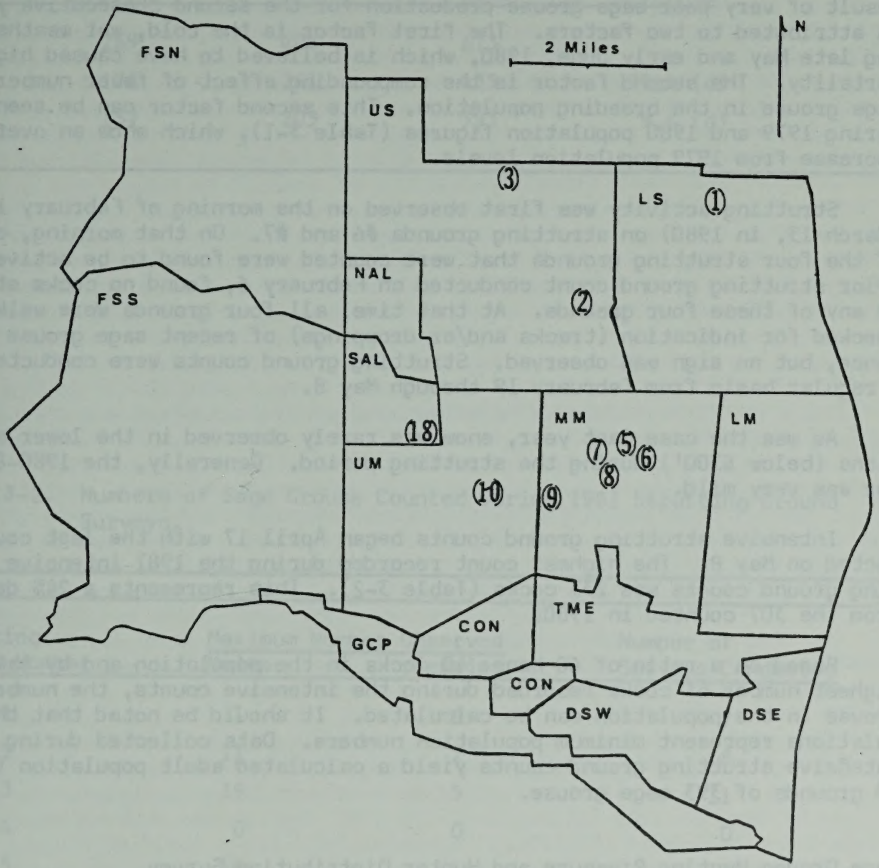

Figure 3-1. General locations of strutting grounds on the Saval Study area.

A secondary population center is located around ground 3 in Upper Sheep pasture. All other grounds are relatively unimportant in terms of numbers of birds present.

1981 population data show that the sage grouse population declined 24% from 1980 population levels. This population decline is believed to be the result of very poor sage grouse production for the second consecutive year and is attributed to two factors. The first factor is the cold, wet weather during late May and early June, 1980, which is believed to have caused high chick mortality. The second factor is the compounding effect of fewer numbers of sage grouse in the breeding population. This second factor can be seen by comparing 1979 and 1980 population figures (Table 3-1), which show an overall 26% decrease from 1979 population levels.

Strutting activity was first observed on the morning of February 19th, (March 13, in 1980) on strutting grounds #6 and #7. On that morning, only two of the four strutting grounds that were counted were found to be active. A prior strutting ground count conducted on February 6, found no cocks strutting on any of these four grounds. At that time, all four grounds were walked and checked for indication (tracks and/or droppings) of recent sage grouse attendance, but no sign was observed. Strutting ground counts were conducted on a regular basis from February 19 through May 8.

As was the case last year, snow was rarely observed in the lower elevations (below 6300') during the strutting period. Generally, the 1980-81 winter was very mild.

Intensive strutting ground counts began April 17 with the last count conducted on May 8. The highest count recorded during the 1981 intensive strutting ground counts was 233 cocks (Table 3-2). This represents a 24% decrease from the 307 counted in 1980.

Based on a ratio of 60 hens: 40 cocks in the population and by taking the highest number of cocks recorded during the intensive counts, the number of grouse in the population can be calculated. It should be noted that these calculations represent minimum population numbers. Data collected during 1981 intensive strutting ground counts yield a calculated adult population for all 10 grounds of 393 sage grouse.

Sage Grouse Hunting Pressure and Hunter Distribution Survey

Sage grouse harvest bag checks conducted at the Mountain City Highway Check Station provided accurate data on sage grouse hunter participation and harvest in the Saval Project area. Harvest bag check, together with follow-up interviews with hunters, also showed that a high percentage of the hunters that hunt the project area, do so year after year, and as a result of this hunter familiarity with the area, hunter information on locations hunted and bird harvest areas is very reliable.

Table 3-1. Summary of Sage Grouse Population Estimates From Intensive Strutting Ground Counts.

Year	Males	Females	Total	% Change
1979	269	404	673	
1980	174	261	435	35.4 (d)
1981	157	203	393	9.6 (d)

Table 3-2. Numbers of Sage Grouse Counted During 1981 Strutting Ground Surveys.

Strutting Ground Number	Maximum Number Observed		Number of Surveys Conducted
	Males	Females	
1	1	0	7
2	11	2	8
3	39	5	11
4	0	0	0
5	16	1	12
6	23	1	11
7	91	10	12
8	9	3	11
9	0	0	4
10	6	2	4
18	19	2	4

On the morning of September 12th, the opening day of the 1981 sage grouse hunting season, the entire Saval Project area and the adjoining area from Pie Creek north, to the southern boundary of the Saval Project, was aerially surveyed. The survey was flown between 0620 hrs. and 0715 hrs. The purpose of the survey was to determine: (1) hunter distribution, (2) hunting pressure, and (3) whether the Mountain City Check Station provided adequate information on hunter participation, distribution, and harvest within the survey area. Data collected during the aerial survey consisted of plotting the location of all vehicles observed on a project map, and writing a brief description of those vehicles. A total of nineteen vehicles was observed, plotted and described, during the aerial survey. Based on vehicle locations observed, 18 hunter parties were determined to be sage grouse hunters and 1 party was believed to be muzzle-loader deer hunting.

Following the aerial survey in the morning of September 12, the Mountain City Check Station was opened and operated from 10:00 a.m. through 6:00 p.m. on the 12th of September, and from 10:00 a.m. through 7:00 p.m. on the 13th of September. At the check station, all hunters that hunted the aerially survey area (Saval and Pie Creek areas) were interviewed by the person that had flown the survey. A base map of the survey area was used to assist hunters in pinpointing the areas where they had hunted and harvested birds.

Based on check station information and ensuing conversations with hunters, all hunters and hunter vehicles observed hunting or within the project and Pie Creek areas during the aerial survey were checked through the Mountain City Check Station during the period it was operated on September 12 and 13. A number of hunters were checked through the station, that had hunted the project area, but were not censused during the aerial survey. These hunters had either not begun hunting the surveyed area untill later in the day, or had not hunted the survey area until Sunday, September 13.

The 1981 sage grouse hunting season on the project area was characterized by declines in both hunting pressure and hunter success. Hunting on the area was rated as poor this year.

Harvest data was collected during the opening weekend of the sage grouse season, September 12 and 13, at the Mountain City Check Station. The Saval Project and Pie Creek Allotment areas were treated as a separate unit for the purpose of harvest data collection. The 1981 sage grouse hunting season was 7 days long, September 12 through September 18, with a limit of 2 birds per day and 4 birds in possession.

The following data were calculated from information collected at the Mountain City Check Station:

Number of Hunters	56
% Successful Hunters	48
Number of Birds Harvested	49
Birds Per Hunter	.88
Birds Per Successful Hunter	1.8
Hunter Days	70
Hours Per Bird	6.1
Birds Seen	448
Minimum Crippling Loss	2
Number of Hunters Per Vehicle	1.8

Both the 1980 and 1981 sage grouse hunting seasons were 7 days long with limits of 2 birds per day and 4 in possession. The following analysis is based on comparisons between 1980 and 1981 harvest data (Table 3-3).

Hunting pressure declined by 14% in 1981. The average number of birds harvested by successful hunters remained relatively unchanged (1.7 in 1980 and 1.8 in 1981), but the percentage of successful hunters decreased 7% in 1981. A comment frequently heard from hunters this year was that sage grouse flushed at greater distances than had been observed in the past, and that many times, although birds were observed, no shots were fired due to the distances at which birds flushed. This may have been partly responsible for the observed decline in hunter success. Analysis of data shows the number of birds reported observed by hunters this year increased significantly from last year despite a 14% decrease in the number of hunters in the field. Further analysis of data, shows that there was a slight decrease (less than 1% fewer in 1981) in the percentage of hunters that were unsuccessful and reported not seeing any birds, and an 8% increase in the number of unsuccessful hunters that had seen at least one bird, but failed in their harvest attempts. The reason more birds were observed by hunters this year is believed to be the result of birds flushing more readily, making them more easily observed.

Data on hunter effort were recorded by both the number of days and the number of hours individual hunters expended in hunting activities. On the average, 1981 hunters spent both fewer days and fewer hours per day hunting as compared to 1980 hunters. The average number of hours required to harvest a bird (hours/bird), based on the total harvest and the total number of hours reported hunted by all hunters, decreased from 8.5 in 1980 to 6.1 in 1981.

The decreases in hunting pressure, hunter effort and the percentage of successful hunters resulted in approximately 20% fewer birds harvested from the project area during the 1981 sage grouse hunting season.

Two sage grouse (1 hen and 1 cock) banded and telemetry transmittered during the spring of 1980, were harvested and checked through the Mountain City bag check station. The hen was reported harvested within 3/4 mile of her capture site and the cock was reported harvested off the project area, approximately 5.3 miles from the capture site. The cock's telemetry transmitter had been recovered from a hunter at the check station.

Sage Grouse Wing Analysis

Beginning in 1978 and continuing through 1981, wings have been collected from sage grouse harvested during the hunting season from the Saval Project and Pie Creek allotment areas. Each year at the end of the sage grouse hunting season, the age and sex of these harvested birds was determined by wing analysis (Crunden 1963).

Wing analysis data are presented in Table 3-4. Wing analysis data support brood survey results, which show that sage grouse production has declined significantly on the project area from 1978 production levels.

Table 3-3. Summary of Hunter Harvest of Sage Grouse (1978-1981)

Year	Percent Successful Hunters	Number of Birds Harvested	Hunter Days	Birds Per Hunter Day
1978	44	106	120	0.88
1979	57	148	128	1.16
1980	55	61	87	0.70
1981	48	49	70	0.70

Table 3-4. Sage Grouse Wing Analysis (1978-1981).

Year	Adult Males	Adult Females	Yearling Males	Yearling Females	Juvenile Males	Juvenile Females
1978	17	20	1	4	18	20
1979	10	19	2	17	15	29
1980	5	5	1	9	8	5
1981	9	13	5	4	2	4

Sage Grouse Brood Surveys

1981 brood surveys show sage grouse production to be up from last years extremely poor production (Table 3-5). This year's increase in production is primarily attributed to more favorable weather conditions than those which existed during the 1980 levels, sage grouse production for 1981 is still classified as poor.

A number of factors are believed to have contributed to this poor production. While the adverse cold, wet, snowy weather that existed during the 1980 nesting/brooding period did not occur during this year's nesting/brooding period very hot and dry conditions did exist during that period this year which resulted in the early drying of some small meadows, portions of larger meadows, and some segments of creeks. It is felt that these climatic and resulting range conditions acted to reduce sage grouse production.

Another factor which may have contributed to reduced sage grouse production, although to a far lesser degree than climatic factors, was the lateness of sage grouse capture activities. Sixteen sage grouse hens, along with a number of cocks, were captured between April 7 and May 11, 1981. All sixteen hens were fitted with telemetry transmitters and monitored. Follow-up monitoring showed that only one of the sixteen transmittered hens was successful in producing a brood, even though three hens were known to be brooding/nesting as evidenced by either brood patches or direct observation of hens on their nests. The extent that actual capture, capture attempts or spotlighting activities disrupt a nesting hen, even though she may not be on her nest at the time, is not known; however, some disturbance is believed to have resulted. To alleviate potential disruptive effects these activities may cause, future capture attempts should be conducted earlier in the year.

In order to better understand how brood survey data were collected, the following explanation is presented. Brood surveys were conducted along the twelve established routes. Random observations made during the July 14 through July 24 survey period are included in survey data (Figure 3-2). However, sage grouse observations which were the direct result of the monitoring of telemetry transmittered sage grouse (i.e. telemetried sage grouse or sage grouse observed in the company of telemetried sage grouse which were observed while conducting radio telemetry follow-up activities) are <u>not</u> included.

Beginning in June and continuing throughout the July survey period, range conditions became steadily drier. The lack of precipitation coupled with hot temperatures and drying winds acted to greatly accelerate desiccation of upland ranges. Also, some small meadows, portions of larger meadows, and some segments of creeks which were found to have been moist and green during brood surveys in 1980, were dry and brown in 1981. Sage grouse reacted to these conditions by concentrating around those areas which still provided water and/or succulent vegetation.

A total of 61 sage grouse (63 in 1980) were observed during 1981 brood surveys. Of these 61 sage grouse, 14 were cocks, 24 were hens and 23 were young (only 3 young were observed in 1980). The 23 young were classified as follows: 3 Class II's, 5 Class III's, and 15 Class IV's. The calculated adult/young ratio was 100/60.5 (100/5 in 1980) and the hen/young ratio was 100/96 (100/9 in 1980). Based on 6 complete broods, the average brood size was 3 young per brood.

Table 3-5. Summary of Brood Surveys (1978-1981).

Year	Total Adults	Total Young	Average Brood Size	Hen/Young Ratio
1978	62	50	4.0	100:192
1979	138	62	3.7	100:102
1980	60	3	-	100:8
1981	38	23	3.0	100:96

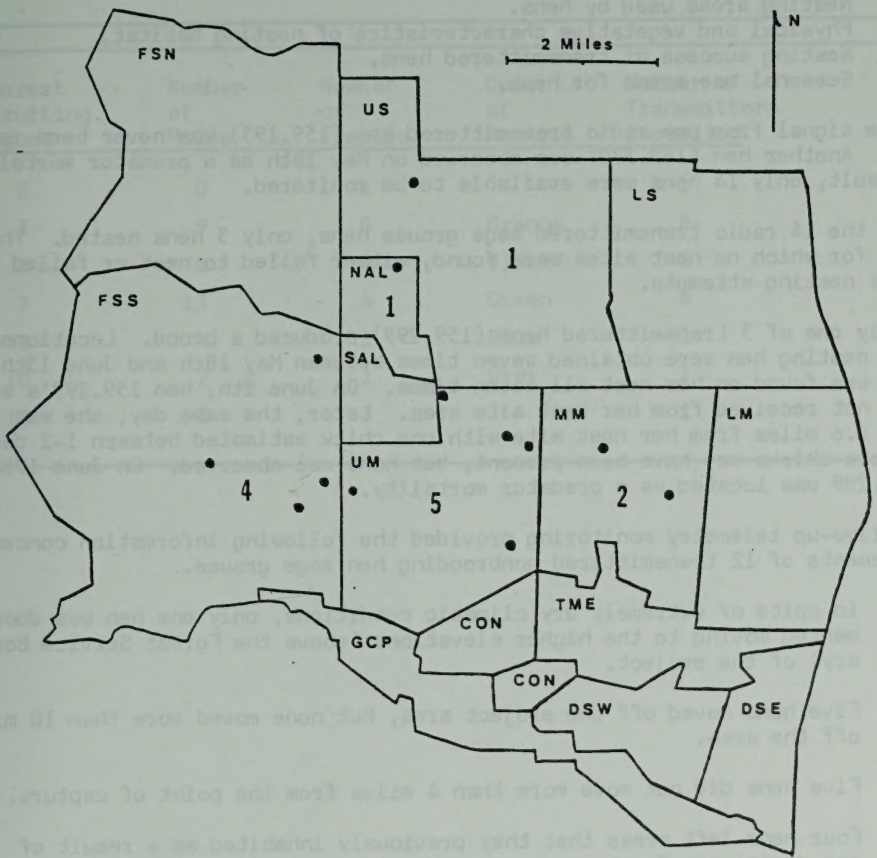

Figure 3-2. Sage grouse brood distribution by pasture.

Sage Grouse Telemetry Follow-up - Figures 3-3 to 3-8

A total of 16 sage grouse hens was captured and fitted with radio telemetry transmitters (Table 3-6). Following capture, all transmittered sage grouse were monitored to determine:

1. Nesting areas used by hens.
2. Physical and vegetative characteristics of nesting habitat.
3. Nesting success of transmittered hens.
4. Seasonal use areas for hens.

The signal from one radio transmittered hen (159.193) has never been received. Another hen (159.370) was observed on May 18th as a predator mortality. As a result, only 14 hens were available to be monitored.

Of the 14 radio transmittered sage grouse hens, only 3 hens nested. The 11 hens for which no nest sites were found, either failed to nest or failed in their nesting attempts.

Only one of 3 transmittered hens (159.299) produced a brood. Locations on this nesting hen were obtained seven times between May 18th and June 15th. The hen was found on her nest all seven times. On June 8th, hen 159.299's signal was not received from her nest site area. Later, the same day, she was located 0.6 miles from her nest site with one chick estimated between 1-2 days old. More chicks may have been present, but none was observed. On June 19th, hen 159.299 was located as a predator mortality.

Follow-up telemetry monitoring provided the following information concerning movements of 12 transmittered nonbrooding hen sage grouse.

1) In spite of extremely dry climatic conditions, only one hen was documented moving to the higher elevations (above the Forest Service Boundary) of the project.

2) Five hens moved off the project area, but none moved more than 10 miles off the area.

3) Five hens did not move more than 4 miles from the point of capture.

4) Four hens left areas that they previously inhabited as a result of the drying up of water courses and associated meadows.

5) During the summer, sage grouse were rarely observed more than ½ mile from water (this statement also takes into account observation of sage grouse other than radio transmittered birds).

6) The habitats most commonly used for shading/loafing activities were areas of big sagebrush and big sagebrush-bitterbrush mix. The most commonly used areas of the type were where big sagebrush was found in small islands or clumps, surrounded by low sage species. Generally, grouse would be located just inside the edges of these big sage islands (See: University of Nevada Reno-Saval Project-1981 Wildlife Habitat Report).

Table 3-6. Summary of Sage Grouse Trapping During 1981.

Nearest Strutting Ground	Number of Males	Number of Females	Color of Markers	Number of Transmitters Installed
2	0	1	-	1
3	9	8	Orange	8
5	4	0	Black	0
7	13	4	Green	4
8	4	1	Blue	1
10	2	1	Grey	1
18	0	1	-	1

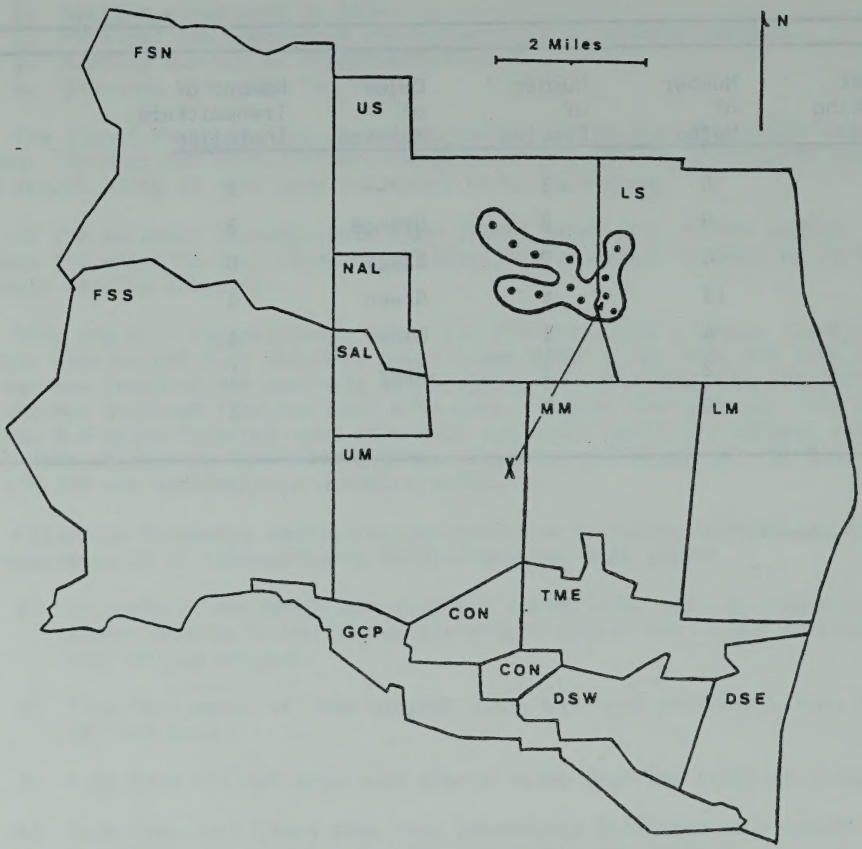

Figure 3-3. Summer home range of female .0920. (X - capture location)

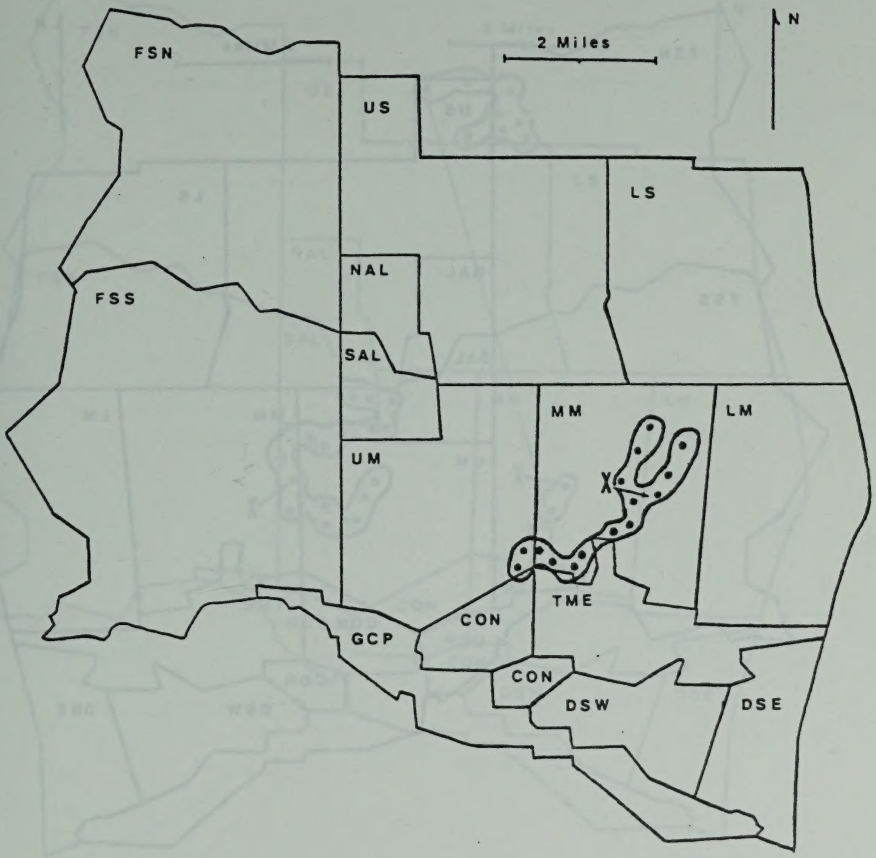

Figure 3-4. Summer home range of female .0435. (X - capture location).

Figure 3-5. Summer home range of female .0018. (X - capture location).

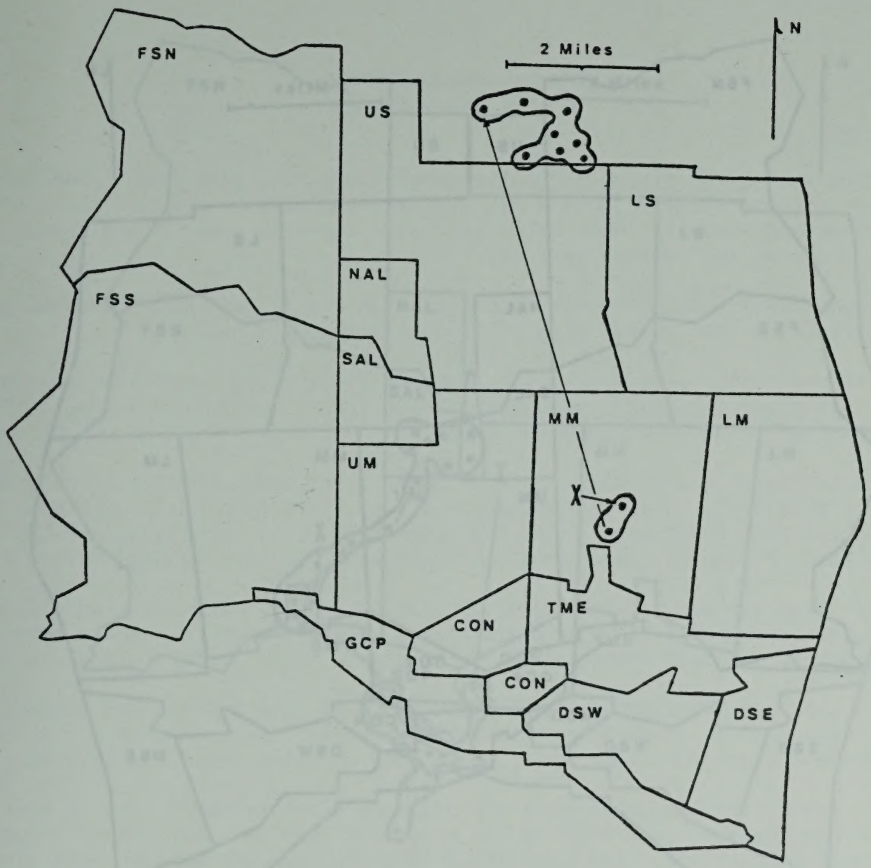

Figure 3-6. Summer home range of female .1335. (X - capture location).

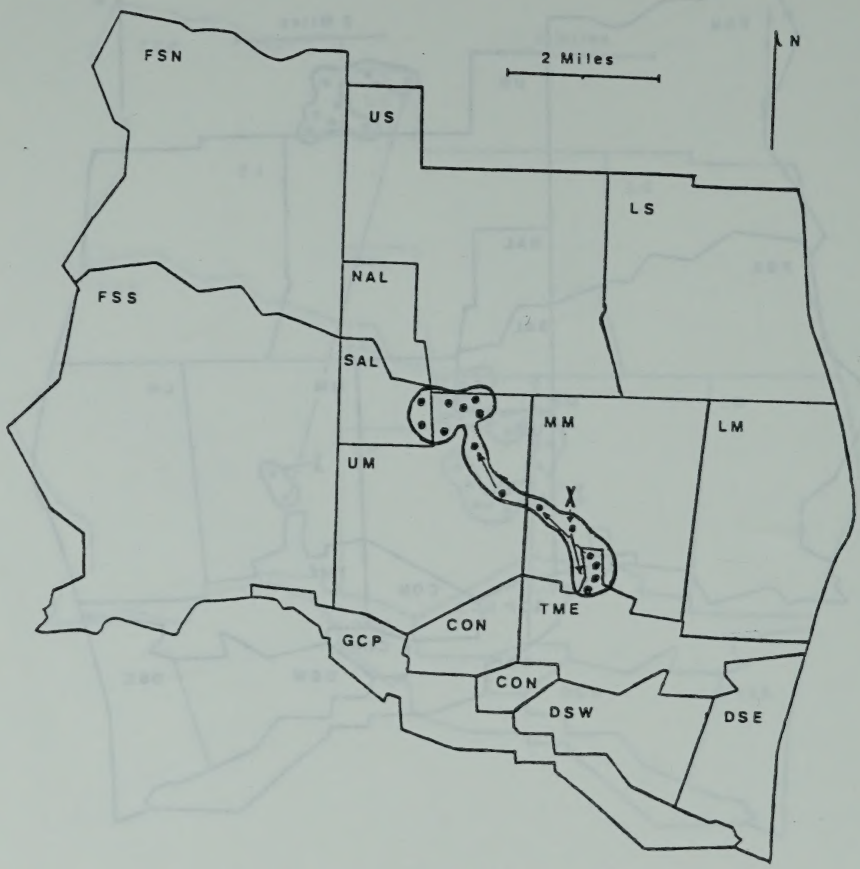

Figure 3-7. Summer home range of female .0643. (X - capture location).

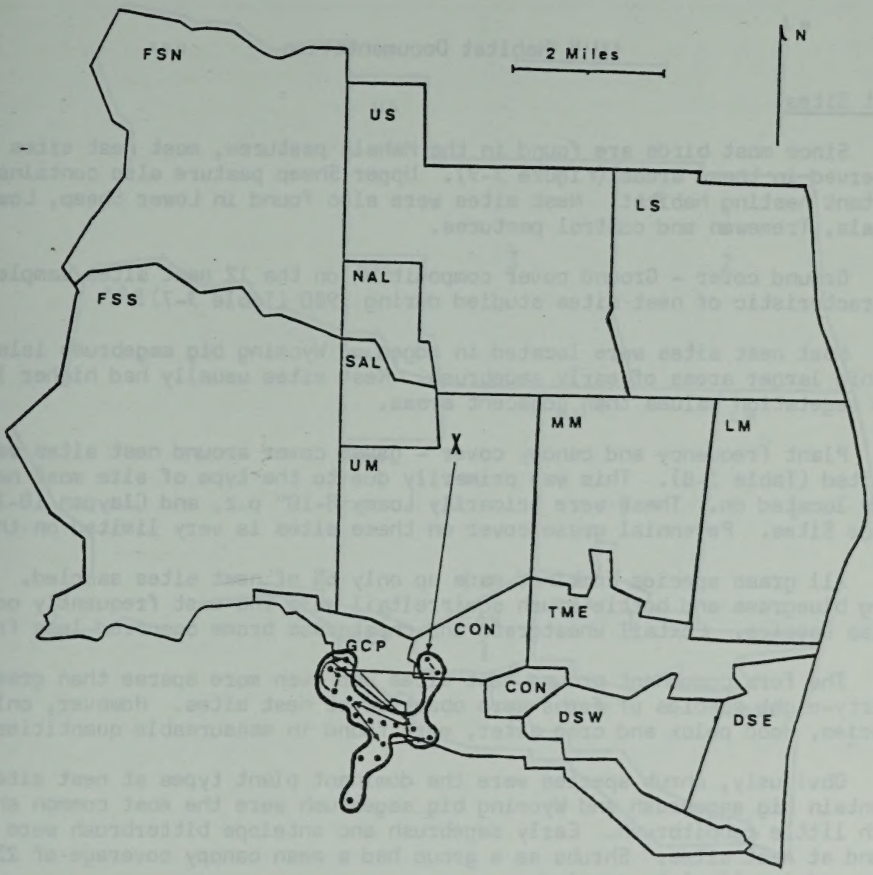

Figure 3-8. Summer home range of female .17. (X - capture location).

All follow-up telemetry monitoring was conducted during daylight hours (no attempts were made to determine sage grouse noctural habitat site selection). Sage grouse locations were not determined on a day by day basis. Also, some grouse, in addition to those determined to be mortalities, were able to be monitored for only a portion of the May 7 - September 22, 1981 reporting period.

Habitat Documentation

Nest Sites

Since most birds are found in the Mahala pastures, most nest sites were observed in these areas (Figure 3-9). Upper Sheep pasture also contains important nesting habitat. Nest sites were also found in Lower Sheep, Lower Mahala, Tremewan and control pastures.

Ground cover - Ground cover composition on the 12 nest sites sampled was characteristic of nest sites studied during 1980 (Table 3-7).

Most nest sites were located in edges of Wyoming big sagebrush islands within larger areas of early sagebrush. Nest sites usually had higher litter and vegetation values than adjacent areas.

Plant frequency and canopy cover - grass cover around nest sites was very limited (Table 3-8). This was primarily due to the type of site most nest sites were located on. These were primarily Loamy 8-10" p.z. and Claypan 10-12" p.z. Range Sites. Perennial grass cover on these sites is very limited on the Saval.

All grass species combined made up only 6% of nest sites sampled. Sandberg bluegrass and bottle brush squirreltail were the most frequently occurring grass species. Foxtail wheatgrass and cheatgrass brome occurred less frequently.

The forb component around nest sites was even more sparse than grasses. Thirty-eight species of forbs were observed at nest sites. However, only two species, Hood phlox and crag aster, were found in measureable quantities.

Obviously, shrub species were the dominant plant types at nest sites. Mountain big sagebrush and Wyoming big sagebrush were the most common shrubs with little rabbitbrush. Early sagebrush and antelope bitterbrush were also found at nest sites. Shrubs as a group had a mean canopy coverage of 23% and occurred in all plots sampled.

Brood Use Areas

Ground cover - Most brood rearing areas were found along stream bottoms and stringer meadows. Therefore, plant production on these sites was much greater than on adjacent upland sites. This is substantiated by ground cover values on brood areas (Table 3-9).

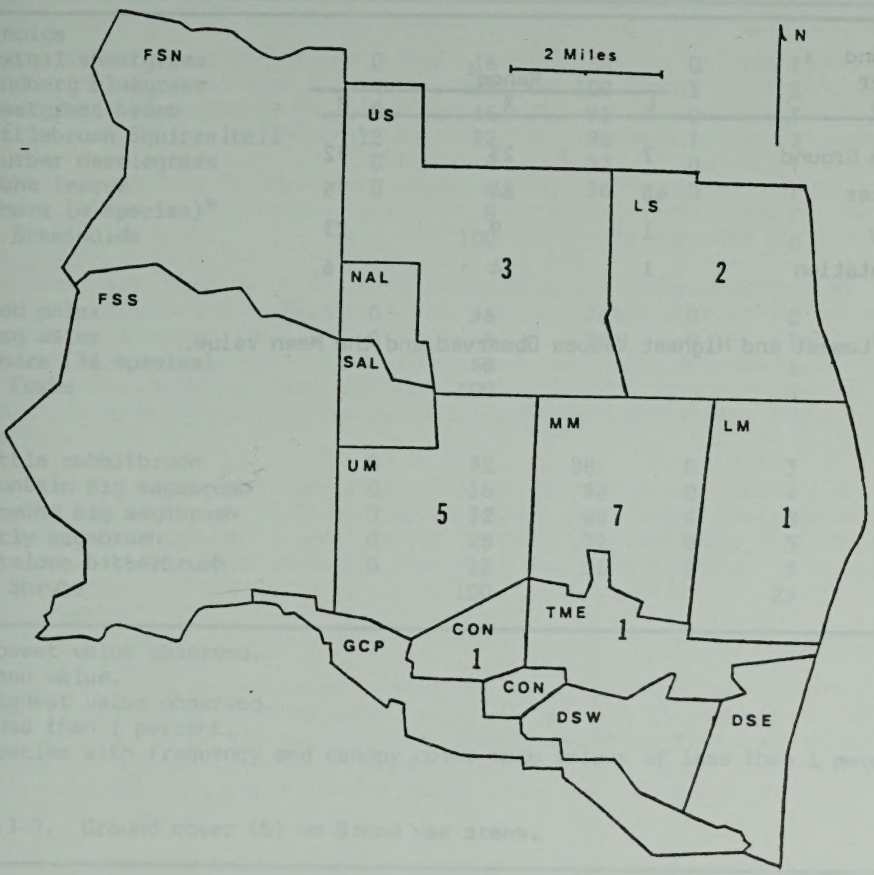

Figure 3-9. Numbers of nest sites found by pasture during 1981.

Table 3-7. Ground Cover (%) on Nest Sites.

Ground Cover Type	Range[1]		
	L	X	H
Bare Ground	7	23	32
Litter	48	64	75
Rock	1	9	23
Vegetation	1	4	6

[1]Lowest and Highest Values Observed and the Mean Value.

Table 3-8. Frequency (%) and canopy cover (%) of plant species on nest sites.

Species	Frequency			Canopy cover		
	L[1]	$\bar{X}$[2]	H[3]	L	X	H
Graminoids						
Foxtail wheatgrass	0	16	68	0	T[3]	2
Sandberg bluegrass	4	68	100	1	2	4
Cheatgrass brome	0	16	92	0	T	7
Bottlebrush Squirreltail	12	72	98	T	2	4
Thurber needlegrass	0	8	32	0	T	1
Idaho fescue	0	4	36	0	T	1
Others (4 species)[4]		8			T	
Total Graminoids		100			6	
Forbs						
Hood phlox	0	36	76	0	2	6
Crag aster	0	8	36	0	T	T
Others (36 species)		68			1	
Total Forbs		100			4	
Shrubs						
Little rabbitbrush	0	32	88	0	3	15
Mountain big sagebrush	0	16	88	0	4	28
Wyoming big sagebrush	0	32	88	0	8	34
Early sagebrush	0	28	72	0	5	20
Antelope bitterbrush	0	12	36	0	3	15
Total Shrubs		100			23	

[1]Lowest value observed.
[2]Mean value.
[3]Highest value observed.
[3]Less than 1 percent.
[4]Species with frequency and canopy cover mean values of less than 1 percent.

Table 3-9. Ground cover (%) on Brood use areas.

Ground Cover Type	Range[1]		
	L	$\bar{X}$	H
Litter	49	73	86
Bare ground	5	18	33
Rock	0	4	20
Vegetation	1	5	10

[1]Lowest and highest values observed and the mean value.

Almost 75% of the ground cover in brood areas was litter. Bare ground values were relatively low when compared to other sites available for use. Values for vegetation were also higher than expected.

Plant frequency and canopy cover - Vegetation types used by broods were very diverse (Table 3-10). There were 113 different plant species identified on the 22 brood areas sampled.

Sedge species were the most abundant graminoid species. Sedges occurred in an average of 24% of the plots sampled with a mean canopy coverage of 6%. Kentucky bluegrass and cheatgrass brome were also common on these sites. Rush species and Nevada bluegrass occurred less frequently.

Canopy coverage of all graminoids was less than 1% with the exception of sedges. However, there was a great amount of variability in canopy cover values for this category of plants.

The forb component was likewise diverse. A total of 73 forb species was recorded for brood sites. However, only 8 species were found in substantial quantities. The most common forb species were poverty sumpweed, northwest cinquefoil and Douglas knotweed. Sage grouse forage species, western aster, western yarrow and common dandelion were less important on these sites both in terms of frequency and canopy coverage. Forbs produced a mean of only 7% canopy coverage.

Shrub cover was only moderate on brood areas as might be expected, since escape cover was adjacent to meadow sites. Mountain big sagebrush and basin big sagebrush were the most common shrub species in and around brood areas. Wyoming big sagebrush and Woods rose were also recorded on these sites.

Adult Use Sites

Ground cover - Ground cover composition on adult use sites during summer months was typical of what was found last year on these sites (Table 3-11). Litter was the most prevalent ground cover type occurring at over 60% of the points sampled. Bare ground values were only moderate. Values for vegetation were suprisingly small. One might expect higher vegetation values on summer use areas.

Plant frequency and canopy coverage - Adult sage grouse chose summer use areas dominated by herbaceous plant species (Table 3-12). However, this choice was less pronounced than for females with broods.

Graminoid species comprised 6% of the canopy cover per plot. Bottlebrush squirrel tail, western wheatgrass and sedge species occurred most frequently with larger canopy cover values. Great basin wildrye and mat muhly were also common on these sites. A total of 17 graminoid species was observed.

Table 3-10. Frequency (%) and canopy cover (%) of plant species on brood use areas.

Species	Frequency			Canopy Cover		
	L[1]	$\bar{X}$[2]	H[3]	L	$\bar{X}$	H
Graminoids						
Sandberg bluegrass	0	28	96	0	T[4]	3
Bottlebrush squirreltail	0	28	92	0	T	3
Foxtail wheatgrass	0	8	36	0	T	3
Sedge	0	24	100	0	6	76
Mat muhly	0	12	72	0	T	11
Nevada bluegrass	0	4	64	0	T	6
Great Basin wildrye	0	12	60	0	T	2
Meadow barley	0	12	72	0	T	3
Rush	0	12	88	0	T	9
Cheatgrass brome	0	16	68	0	T	12
Western wheatgrass	0	8	60	0	T	3
Kentucky bluegrass	0	16	80	0	1	16
Red top	0	4	80	0	T	2
Others (15 species)[5]		14			T	
Total Graminoids		100			13	
Forbs						
longleaf phlox	0	12	52	0	T	T
Low pussytoes	0	8	36	0	T	T
Poverty sumpweed	0	16	100	0	1	14
Western aster	0	12	80	0	T	3
Western yarrow	0	20	80	0	T	3
Common dandelion	0	12	64	0	T	1
Northwest cinquefoil	0	20	80	0	1	9
Douglas knotweed	0	8	68	0	T	9
Others (65 species)		84			2	
Total Forbs		100			7	
Shrubs						
Antelope bitterbrush	0	4	52	0	1	14
Woods rose	0	12	72	0	T	11
Basin big sagebrush	0	12	80	0	3	27
Mountain big sagebrush	0	12	100	0	3	20
Little rabbitbrush	0	12	60	0	1	8
Wyoming big sagebrush	0	16	84	0	4	18
Rubber rabbitbrush	0	4	36	0	1	12
Others (4 species)		4			T	
Total Shrubs		76			14	

[1]Lowest value observed.
[2]Mean value.
[3]Highest value observed
[4]Less than 1 percent.
[5]Species with frequency and Canopy cover mean values of less than 1 percent.

Table 3-11. Ground cover (%) on adult sage grouse use areas (summer).

Ground Cover Type	Range[1]		
	L	$\bar{X}$	H
Litter	38	63	94
Bare ground	4	26	54
Rock	0	8	40
Vegetation	0	3	7

[1]Lowest and highest values observed and the mean values.

Table 3-12. Frequency (%) and canopy cover (%) of plant species on adult sage grouse use areas (summer).

Species	Frequency			Canopy Cover		
	L[1]	$\bar{X}$[2]	H[3]	L	$\bar{X}$	H
Graminoids						
Sandberg bluegrass	0	52	80	0	T[4]	3
Bottlebrush squirreltail	0	48	100	0	1	3
Western wheatgrass	0	20	100	0	1	7
Sedge	0	12	84	0	T	7
Foxtail wheatgrass	0	12	60	0	T	1
Cheatgrass brome	0	8	24	0	T	T
Great Basin wildrye	0	8	60	0	T	2
Nevada bluegrass	0	8	44	0	T	5
Thurber needlegrass	0	8	40	0	T	1
Mat muhly	0	4	24	0	T	4
Rush	0	3	16	0	T	T
Meadow barley	0	2	16	0	T	T
Idaho fescue	0	2	20	0	T	T
Others (4 species)[5]		20			1	
Total Graminoids		100			7	
Forbs						
Hood phlox	8	32	72	T	1	3
Poverty sumpweed	0	20	76	0	T	2
Longleaf phlox	0	12	68	0	T	1
Crag aster	0	12	44	0	T	1
Western yarrow	0	8	32	0	T	T
Prickly sandwort	0	7	80	0	T	2
Western aster	0	4	20	0	T	T
Northwest cinquefoil	0	4	40	0	T	T
Combleaf cinquefoil	0	3	20	0	T	1
Low pussytoes	0	3	20	0	T	T
Low penstemon	0	3	16	0	T	T
Tapertip hawksbeard	0	3	28	0	T	T
Littleflower collinsia	0	3	12	0	T	T
Holboell rockcress	0	2	8	0	T	T
Twincrest onion	0	2	8	0	T	T
Mat eriogonum	0	2	16	0	T	2
Arcane milkvetch	0	2	12	0	T	T
Slenderleaf erigeron	0	2	20	0	T	T
Lewis eriogonum	0	2	16	0	T	T
Pursh locoweed	0	2	12	0	T	T
Others (26 species)	17				2	
Total Forbs		100			10	
Shrubs						
Little rabbitbrush	0	28	60	0	2	7
Early sagebrush	0	24	80	0	5	25
Basin big sagebrush	0	20	68	0	4	17
Wyoming big sagebrush	0	20	52	0	5	12
Antelope bitterbrush	0	12	36	0	2	7
Woods rose	0	2	16	0	T	T
Golden currant	0	2	12	0	T	T
Others (4 species)		32			3	
Total Shrubs		100			22	

[1]Lowest value observed.
[2]Mean value.
[3]Highest value observed.
[4]Less than 1 percent.
[5]Species with frequency and Canopy cover mean values of less than 1 percent.

The forb component was only moderately diverse. A total of 46 forb species was recorded on adult sites. Hood phlox, poverty sumpweed, longleaf phlox and prickly sandwort were the most common forb species. Forage items such as western yarrow, western aster and cinquefoil occurred only in moderate amounts.

Early sagebrush was the dominant shrub species on adult sites. Little rabbitbrush, basin big sagebrush and Wyoming big sagebrush were less frequent on these sites. A total of 11 species of shrubs was recorded in these areas. Mean canopy coverage of shrubs was 22%.

Lower Sheep Pasture Study

Population and Movements

Data on population and movements in and around Lower Sheep pasture is extremely limited and will not be discussed in this report. Subsequent reports should provide some answers to this complex problem.

Habitat Documentation

The Lower Sheep pasture was much more complex in terms of number of vegetation types than originally thought (Figure 3-10). Twenty-six different vegetation types were described in this pasture.

Ground Cover

Ground cover composition was as complex as the vegetation patterns (Table 3-13). Almost any combination of ground cover types was observed. Upland types were dominated by higher bare ground and rock values, whereas the drainage bottom types were dominated by higher litter values.

Plant Frequency and Canopy Cover

Sandberg bluegrass and bottlebrush squirreltail were common in most types with the exception of type 31 or meadow type. Meadows were dominated by meadow barley and Nevada bluegrass (Table 3-14).

Forb species composition varied a great deal more than did the grass component. Such species as Hood phlox and crag aster occurred in many of the types. However, these two species were more prevalent on upland types.

Longleaf phlox, low penstemon, malted cryptantha and holboell rockcress were found in moderate amounts primarily on upland types.

Sage grouse summer forage species such as western yarrow, western aster and common dandelion were obviously restricted to moist drainage bottoms.

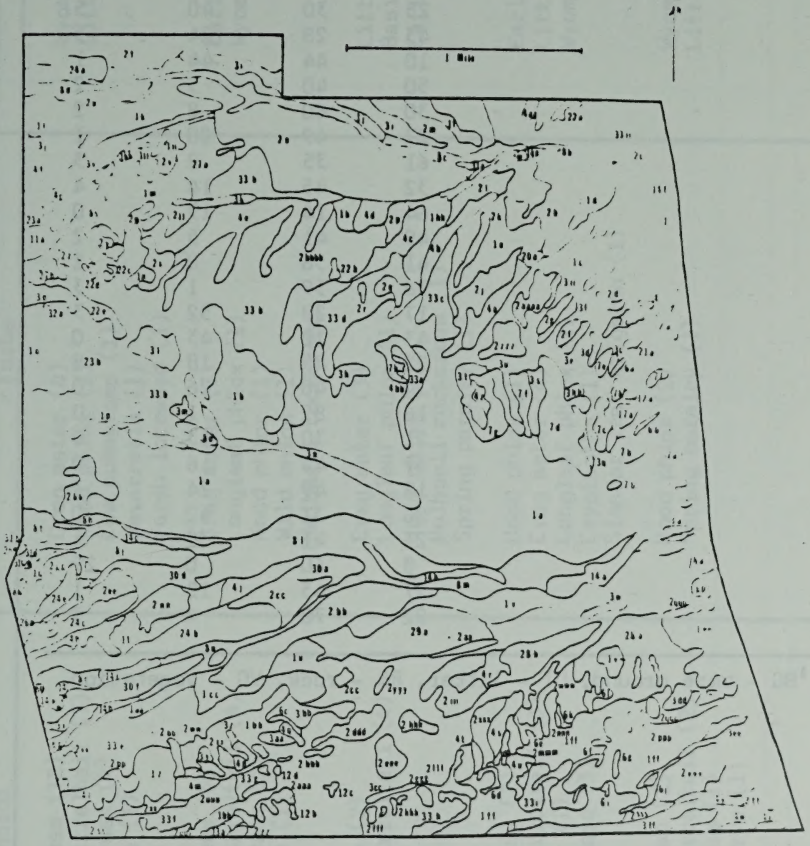

Figure 3-10. Vegetation types of Lower Sheep pasture.

Table 3-13. Ground cover composition (%) in each vegetation type in lower sheep pasture.

Vegetation Type	Ground Cover Type[1]			
	BG	LT	Rk	VG
1	25	30	40	5
2	43	28	24	5
3	10	44	44	1
4	50	40	5	2
6	30	60	8	2
7	27	49	20	1
8	61	35	2	3
11	32	45	14	4
12	64	14	19	0
13	49	41	5	2
14	41	56	0	2
17	36	59	1	3
21	17	28	52	3
22	43	12	43	0
23	22	49	18	8
24	34	40	26	0
25	16	82	1	0
26	21	30	43	0
27	37	44	16	0
28	18	49	24	3
29	26	31	42	0
30	21	41	32	4
31	8	60	0	29
32	37	45	12	1
33	22	70	4	3

[1]BG - bare ground, LT - litter, Rk - rock, VG - vegetation.

Table 3-14. Canopy Cover (%) of the most common platn species in Lower Sheep Pasture.

Vegetation Type	Species (Canopy Cover)		
	Graminoids	Forbs	Shrubs
1	Sandberg bluegrass (12) Bottlebrush squirreltail (7) Thurber needlegrass (4) Cheatgrass brome (1)	Crag aster (4) Hood phlox (2) Low pussytoes (1) Navarretia (1) Pursh locoweed (1)	Wyoming big sagebrush (30) Little rabbitbrush (10)
2	Sandberg bluegrass (5) Bottlebrush squirreltail (4) Thurber needlegrass (5) Cheatgrass brome (1)	Crag aster (3) Longleaf phlox (1) Hood phlox (1) Wild onion (1) Holboell rockcress	Early sagebrush (10) Wyoming big sagebrush (2)
3	Cheatgrass brome (2) Bottlebrush squirreltail (4)	Crag aster (3) Longleaf phlox (1) Hood phlox (1) Holboell rockcress (1) Spring parsley (1)	Little rabbitbrush (5) Basin big sagebrush (5) Early sagebrush (3)
4	Sandberg bluegrass (2) Bottlebrush squirreltail (3) Cheatgrass brome (1) Thurber needlegrass (3)	Hood phlox (1) Crag aster (4) Longleaf phlox (1) Cryptantha (1) Slender leaf erigeron (1)	Early sagebrush (10) Little rabbitbrush (12) Wyoming big sagebrush (2)
6	Sandberg bluegrass (2) Bottlebrush squirreltail (2) Kentucky bluegrass (1) Great Basin wildrye (1)	Hood phlox (2) Spring parsley (1)	Wyoming big sagebrush (25) Little rabbitbrush (10)

Table 3-14. (Con.t)

Vegetation Type	Species (Canopy Cover)		
	Graminoids	Forbs	Shrubs
7	Cheatgrass brome (1) Sandberg bluegrass (3) Bottlebrush squirreltail (3) Thurber needlegrass (1)	Pursh locoweed (1) Crag aster (1) Low penstemon (1) Malted cryptantha (1)	Little rabbitbrush (12) Wyoming big sagebrush (8)
8	Great Basin wildrye (12) Bottlebrush squirreltail (2)	Western aster (3)	Rubber rabbitbrush (30) Basin big sagebrush (10)
11	Sandberg bluegrass (6) Cheatgrass brome (1) Bottlebrush squirreltail (2) Thurber needlegrass (2)	Arcane milkvetch (1) Mat eriogonum (2) Tapertip hawksbeard (1) Malted cryptantha (1) Crag aster (2)	Wyoming big sagebrush (6)
12	Cheatgrass brome (1) Bottlebrush squirreltail (1)	Hood phlox (2)	Gray horsebrush (20) Little rabbitbrush (3)
13	Cheatgrass brome (2) Bottlebrush squirreltail (2) Great Basin wildrye (1)	Longleaf phlox (1) Navarretia (1) Tallcup Tupine (2) Thistle (1)	Wyoming big sagebrush (2)
14	Great Basin wildrye (20) Nevada bluegrass (10) Mat muhly (6) Sandberg bluegrass (2)	Poverty sumpweed (1) Lanceleaf goldenweed (1) Louisiana sagebrush (4) Western yarrow (2) Western aster (1)	Basin big sagebrush (20) Rubber rabbitbrush (15)
17	Bottlebrush squirreltail (2) Cheatgrass brome (1) Indian ricegrass (1)	Desert globemallow (1)	Wyoming big sagebrush (30) Spiny hopsage (1)

Table 3-14. (Con.t)

Vegetation Type	Species (Canopy Cover)		
	Graminoids	Forbs	Shrubs
21	Bottlebrush squirreltail (2) Sandberg bluegrass (2) Thurber needlegrass (1)	Crag aster (1) Hood phlox (1) Holboell rockcress (1) Low penstemon (1) Low pussytoes (1) Plains pricklypear (1) Cryptantha (1)	Wyoming big sagebrush (10) Little rabbitbrush (6) Early sagebrush (5)
22	Bottlebrush squirreltail (2) Thurber needlegrass (1)	Prickly phlox (2) Tufted evening primrose (1) Plain pricklypear (1) Eriogonum (1)	Little rabbitbrush (8) Wyoming big sagebrush (5) Gray horsebrush (2)
23	Sandberg bluegrass (3) Bottlebrush squirreltail (2) Cheatgrass brome (1)	Longleaf phlox (1) Hood phlox (1) Low penstemon (1) Arcane milkvetch (1) Low pussytoes (1) Tapertip hawksbeard (1)	Early sagebrush (8) Wyoming big sagebrush (1)
24	Cheatgrass brome (2) Sandberg bluegrass (2) Bottlebrush squirreltail (2) Thurber needlegrass (1)	Longleaf phlox (1) Wild onion (1) Crag aster (1) Spring parsley (1) Pale agoseris (1) Pursh locoweed (1) Agressive locoweed (1) Plains pricklypear (1) Low pussytoes (1)	Wyoming big sagebrush (10) Rubber rabbitbrush (1)

Table 3-14. (Con.t)

Vegetation Type	Species (Canopy Cover)		
	Graminoids	Forbs	Shrubs
25	Cheatgrass brome (1) Sandberg bluegrass (1) Bottlebrush squirreltail (1)	Malted cryptantha (1) Hood phlox (1) Field pennycress (1)	Basin big sagebrush (30) Woods rose (25) Antelope bitterbrush (2) Little rabbitbrush (2)
26	Cheatgrass brome (1) Sandberg bluegrass (5) Bottlebrush squirreltail (2) Thurber needlegrass (2)	Longleaf phlox (1) Low penstemon (1) Holboell rockcress (1) Pursh locoweed (1) Low cryptantha (1) Spring parsley (1) Plains pricklypear (1) Tapertip hawksbeard (1)	Little rabbitbrush (5) Wyoming big sagebrush (2) Rubber rabbitbrush (1)
27	Bottlebrush squirreltail (3) Sandberg bluegrass (2)	Crag aster (2) Longleaf phlox (1) Lewis eriogonum (1) Holboell rockcress (1)	Early sagebrush (25)
28	Bottlebrush squirreltail (6) Sandberg bluegrass (1)	Crag aster (1) Longleaf phlox (1) Low pussytoes (1) Pursh locoweed (1) Agressive locoweed (1) Malted cryptantha (1)	Early sagebrush (10) Little rabbitbrush (2) Wyoming big sagebrush (2)
29	Sandberg bluegrass (3) Bottlebursh squirreltail (5) Cheatgrass brome (1)	Longleaf phlox (1) Crag aster (1) Low penstemon (1) Prickly phlox (1) Spring parsley Gray hawksbeard (1) Agressive locoweed (1)	Wyoming big sagebrush (10) Early sagebrush (8)

Table 3-14. (Con.t)

Vegetation Type	Species (Canopy Cover)		
	Graminoids	Forbs	Shrubs
30	Sandberg bluegrass (7) Bottlebrush squirreltail (3) Cheatgrass brome (1) Thurber needlegrass (4)	Hood phlox (1) Crag aster (1) Holboell rockcress (1) Pursh locoweed (1) Low penstemon (1) Spreading fleabane (1) Prickly phlox (1) Malted cryptantha (1)	Wyoming big sagebrush (15) Little rabbitbrush (2) Rubber rabbitbrush (1)
31	Meadow barley (5) Nevada bluegrass (4) Inland saltgrass (3) Rush (5) Sedge (4)	Western aster (2) Lanceleaf goldenweed (1) Western yarrow (2) Common dandelion (2) Rocky Mountain buttercup (1)	No shrubs present
32	Bottlebrush squirreltail (2) Cheatgrass brome (1) Sandberg bluegrass (3)	Poverty, sumpweed (1) Autumn willowweed (1) Douglass knotweed (1) Pinnate tansy mustard (1) Hood phlox (1) Foothill deathcamas (1) Desert globemallow (1) Slender leaf erigeron	Wyoming big sagebrush (2)
33	Bottlebrush squirreltail (3) Sandberg bluegrass (2) Cheatgrass brome (1) Thurber needlegrass (1)	Hood phlox (1) Tallcup lupine (2) Agressive locoweed (1)	Wyoming big sagebrush (40) Little rabbitbrush (2)

Shrubs were the most important plant type in segregating vegetation types in Lower Sheep pasture. Upland types such as 1, 6, 7, 13, 24 and 33 were dominated exclusively by Wyoming big sagebrush and little rabbitbrush.

Many types such as 2, 3, 4, 21, 28, and 29 were characterized by mixtures of big sagebrush subspecies and early sagebrush. In many of these areas, big sagebrush (particularly Wyoming big sagebrush) formed islands within larger areas of early sagebrush, creating a mosaic pattern. Also some of these types were characterized by islands of early sagebrush within larger expanses of big sagebrush.

Vegetation types in the drainage bottoms (8 and 14) were characteristic of other low areas of the study area. These types were exclusively dominated by basin big sagebrush and rubber rabbitbrush. Little rabbitbrush and silver sagebrush were infrequent on these types.

There are a few small and unique vegetation types in Lower Sheep pasture that are dominated by plant species not common on the Saval. Types 12 and 22 are located on somewhat calcareous soil with much gray horsebrush cover.

Vegetation Types and Sage Grouse Dropping Density(Table 3-15).

Over 25% of the Lower Sheep pasture is composed of vegetation type 1, comprising over 1600 acres. However, most of this type is found in large intact areas. Thirty-four droppings were found per acre on this type.

Although type 2 occurred in only half the area that type 1 did, it was found at twice the number of locations. That is, it was more broken up in its distribution. Roughly 5 times more droppings were observed on type 2 than type 1.

Type 3 was found on over 200 acres but was of little use to sage grouse, as exhibited by the number of droppings found.

Type 4 is one of the more important types in Lower Sheep pasture . It occurred on only 200 acres but over 250 droppings were counted per acre.

Although types 11, 17, 23, 26, 27 and 31 occurred in very few locations and at very low acreages, they were very important based on dropping numbers.

In types where shrub canopy coverage was very high, such as 6, 7, 8, 14, 25 and 33, very few droppings were found.

Table 3-15. Vegetation types and sage grouse dropping densities in Lower Sheep pasture.

Vegetation Type	Number of Acres In Pasture	Number of Locations Sampled	Number of Droppings Found Per Acre
1	1650	29	34
2	925	63	178
3	242	30	16
4	202	23	263
6	23	11	7
7	105	12	34
8	275	15	12
11	17	1	137
12	2	4	7
13	3	1	7
14	77	9	8
17	4	1	7
20	3	1	82
21	1	1	7
22	15	5	7
23	79	2	137
24	99	5	38
25	1	1	54
26	7	1	263
27	30	2	500
28	81	2	111
29	53	1	67
30	66	3	67
31	3	4	312
32	1	1	7
33	198	11	27

Summary and Conclusions

Sage grouse populations on the Saval study have undergone a drastic decline in the last two years. This decline has been more or less uniform over the study area. Weather conditions are probably one of the primary reasons for this decline.

Many of the yearly activities of grouse were altered by lack of snowfall during winter months and periods of cold, wet weather during hatch period.

These factors have combined to have a drastic effect on the sage grouse research on the Saval. At the present time we don't know what effect weather is having on grouse movements or their habitat utilization. However, we do know that non-brooding female sage grouse did exhibit erratic movement patterns during summer and fall months.

Habitats used by sage grouse during summer months were tied to unique vegetation structure and type. Islands of big sagebrush within larger areas of early sagebrush were heavily utilized for nesting and loafing habitat. This mosaic pattern is particularly evident in Middle Mahala, Upper Mahala and Upper Sheep pastures.

Brood activity was closely associated with riparian habitat during summer and early fall. Ecotones between riparian vegetation types and upland types seemed to be of particular importance.

Based on dropping transect work, sage grouse in Lower Sheep pasture also exhibited a preference for mosaic areas. Obviously, the meadow areas in Lower Sheep were heavily utilized by sage grouse.

There has been some controversy on the applicability of the dropping transect method to habitat utilization. It has been said that we are measuring roosting sites, when in fact we should be measuring adjacent feeding habitats. If this is the case, then there are computer techniques to correct this. The feasibility of these techniques are presently being studied for application on the Saval. If we can accomplish this, it would be a great aid in telemetry work.

CHAPTER 4.

MULE DEER RESEARCH

Mike Wickersham and Donald A. Klebenow

1981 Objectives:

1. To capture and train mule deer fawns for food habits research to be initiated during the 1982 season.

2. To determine the seasons of mule deer use on the project area.

3. To determine the mule deer migration routes.

4. To determine the winter ranges utilized by deer inhabiting the project area.

1981 Accomplishments:

1. Eight mule deer fawns were captured, seven were reared and trained.

2. A hunter bag check was made of mule deer harvest.

3. Fifteen mule deer were captured on the project, nine were radio tagged, six were ear marked only.

4. The fall-winter deer distribution survey was completed.

5. Completed the preseason deer distribution survey.

6. All the radio collared deer were monitored.

Mule Deer Fawn Capture and Rearing for Food Habits Research

Eight mule deer fawns were captured the first week of June. One failed to survive. The remaining seven were hand reared at the research headquarters on the haystack Ranch, Elko County. A box that fits into a pickup truck was constructed and the fawns were trained to enter to permit transport. They were hauled in the truck to condition them for field use.

In late summer, after weaning, they were taken into the field and trial runs were made to aid in developing sampling plans for the oncoming research.

The fawns were trucked to Wadsworth, Nevada, to the S-S Field Laboratory, University of Nevada, where they have been kept through the winter.

A detailed study plan based on the recommendations of the research modelling workshops held in December, 1981 and January, 1982, is being developed for this research phase. Research will be initiated in May, 1982.

Big Game Bag Check Summary

October 4 - November 2, 1980

Twelve hunters (28 in 1979) that had hunted the project area were checked. The 12 hunters harvested 7 bucks in 47 days of hunting, for a 54% hunter success (38% in 1979) and an average 2.5 days of hunting per successful hunter.

The 1980 Control General Hunt #1131 ran from October 4 through November 2, 1980. Bag checks were conducted on the weekends of October 4th and 5th, and November 1st and 2nd. Table 4-1 shows comparisons between 1978, 1979, and 1980 bag check harvest data.

Deer Trapping - Saval Project (Sheep Creek)

October 25 - November 25, 1980

A total of 14 deer were captured and tagged from the Sheep Creek area of the Project during trapping operations. Of the 14 deer: 7 were does (yearlings or older), 5 were buck fawns and 2 were doe fawns. All 14 deer were marked for later identification with numbered aluminum and numbered white (T-lok) ear tags. Nine of these deer (7 does, 1 doe fawn and 1 buck fawn) were fitted with radio telemetry collars. A summary of trapping activities by day (Table 4-2) and trapping forms 253 (Apendix A) are attached.

The purpose of this trapping operation was to capture and radio telemetry collar 9 deer from the project area. Radio collared deer were to be used to better identify:

1. Seasons of deer use on the project area
2. Deer migration routes
3. Winter ranges utilized by deer inhabiting the project area.

The results of the monitoring of radio collar deer are presented in a later section of this report (See: Deer Telemetry Follow-up).

Fall-Winter Deer Distribution Survey-Figures 4-1 and 4-2

December 11, 1980

Deer distribution, the number of deer groups and average group size of deer were oberved to be the same or similar to observations during the 1979 Fall-Winter survey.

Table 4-1

DEER BAG CHECK - RIFLE SEASON

Saval Project

YEAR	NUMBER OF HUNTERS CHECKED	NUMBER OF SUCCESSFUL HUNTERS	PERCENT SUCCESSFUL HUNTERS	NUMBER DAYS HUNTED	AVERAGE DAYS PER HUNTER	POINT CLASS HARVESTED				
						1	2	3	4	5+
1978	73	16	22	101	1.4		7	5	4	
1979	27	12	44	34	1.2		4	5	1	2
1980	12	7	58	47	3.9		4	2		1

Table 4-2

SUMMARY OF DEER TRAPPING ACTIVITIES - 1980

Saval Project

Date	Does	Bucks	Fawns Bucks	Fawns Does	Total Deer	Trap Nights	% Trap Success
11/11/80			1	1	2	6	33%
11/12/80			1		1	6	17%
11/14/80	2		2		4	6	67%
11/15/80				1	1	6	17%
11/18/80	2			1	3	5	20%
11/19/80	3		1		4	5	80%
11/20/80	1				1	5	20%
11/21/80	1		1	1	3	5	60%
11/25/80	2				2	5	40%
Totals	11	0	6	4	21	49	43%
							Average trapping success

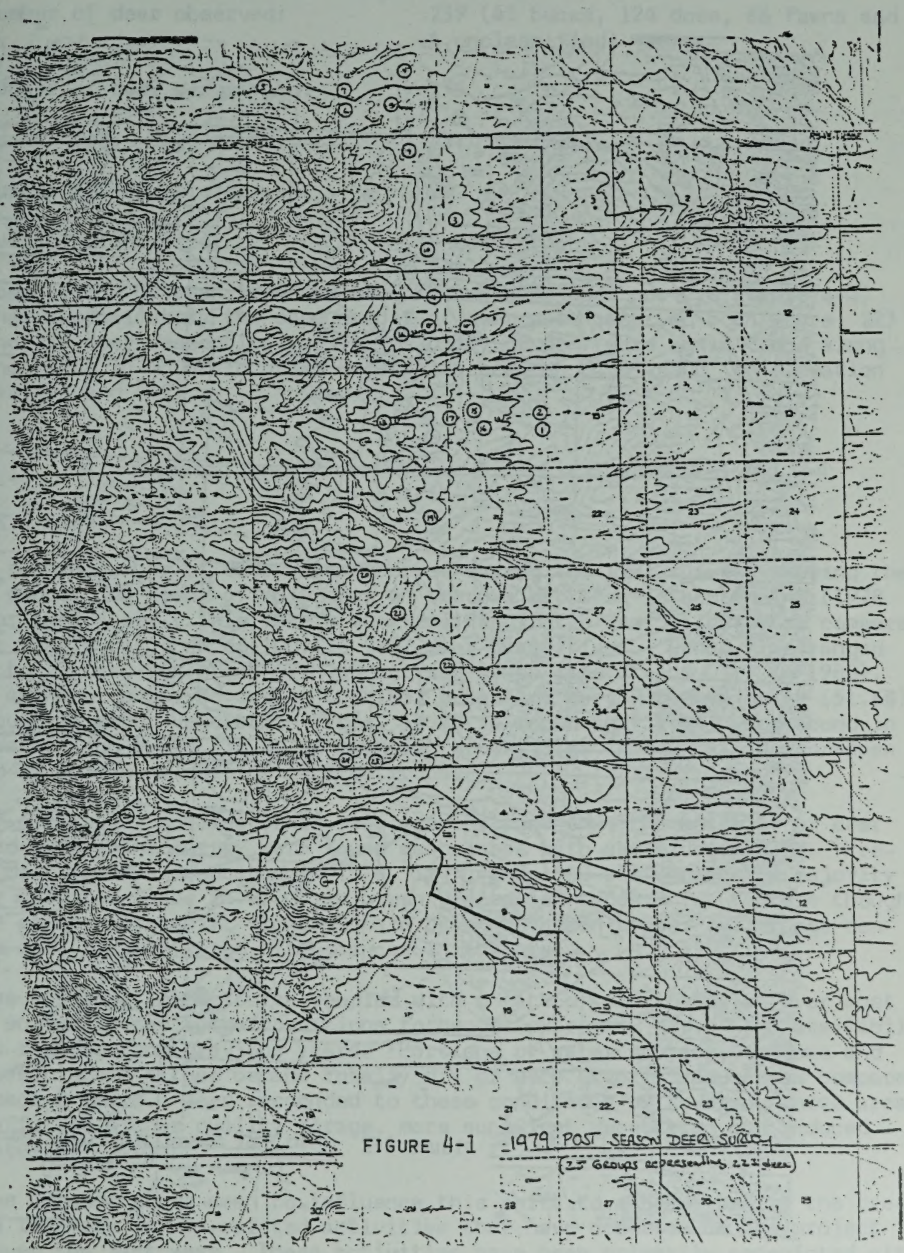
1979 POST SEASON DEER SURVEY
(25 GROUPS REPRESENTING 222 DEER)

FIGURE 4-1

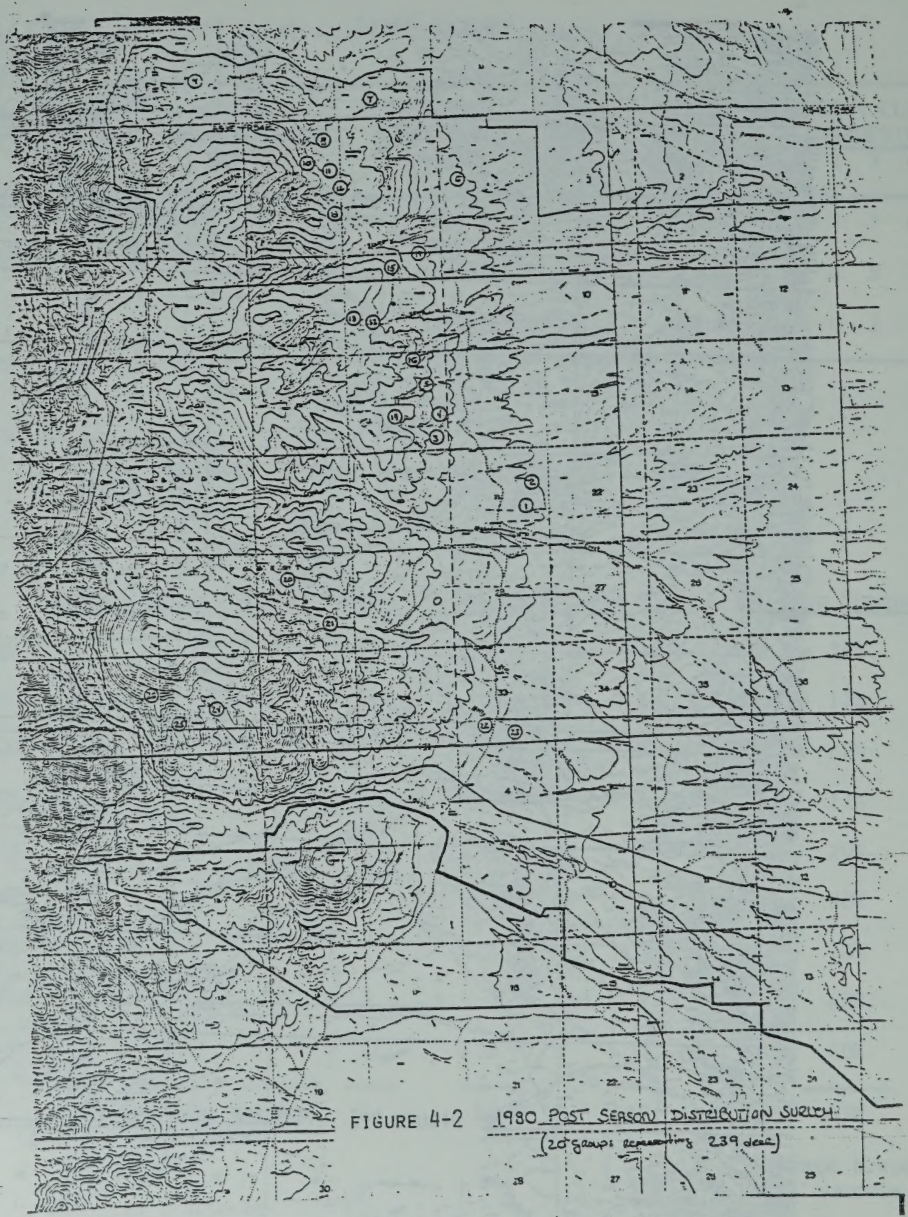

FIGURE 4-2 1980 POST SEASON DISTRIBUTION SURVEY
(20 groups representing 239 deer)

The following was calculated from data collected during the 1.7 hour Fall-Winter deer distributon survey.

Number of deer observed:	239 (45 bucks, 124 does, 66 fawns and 4 unclassified)
Number of deer classified:	235
Buck: Doe: Fawn ratio:	37: 100: 53
Number of groups observed:	26
Average group size:	9 deer/group

Comparisons between 1979 and 1980 Fall-Winter deer surveys (Table 4-3) show that approximately the same number of deer were observed both years, 223 deer and 239 deer respectively. The majority of deer were again found along the bench area in mountain brush vegetation between 6400'-6800' in elevation (Figures 4-1 and 4-2).

Preseason Deer Distribution Survey - Figures 4-3 and 4-4

October 6, 1981

A record number of deer were observed during the 1981 survey, showing the upward population trend of mule deer on the project area is continuing (1978 used for base year). This year's buck:doe:fawn ratio was 52:100:89 as compared to last year's ratio of 66:100:116 (227 deer classified). Group size ranged from 1 to 12 deer per group with an average group size of 3.9 (3.7 in 1980). Of the 405 deer observed during the 1981 preseason survey the majority (51.6%) were found in aspen vegetation types, 36.8% in mountain (51.6%) were found in aspen vegetation types, 36.8% in mountain brush, 9.6% in mountain brush/aspen mix and 2% in high elevation rock outcrops.

Of particular interest this year was the fact that the majority of deer observed during the survey were found associated with aspen vegetation. Preseason deer surveys conducted in 1978, 1979, and 1980 all showed the majority of deer observed to be in mountain brush vegetation types. Two factors thought to have caused this shift from mountain brush to aspen types: (1) range conditions and (2) man caused disturbances in the area.

Above normal temperatures coupled with a lack of precipitation over most of the summer caused range conditions to become extremely dry. Forb availability was reduced from previous years. Portions of water courses, meadows and other mesic areas either became totally dry or were greatly reduced as compared to preceding years. Deer responded to these conditions by favoring those areas which afforded higher quality forage, more succulent vegetation and reduced temperatures.

The second factor seen to influence this shift to aspen types is the tremendous increase in man-related activities that have occurred on the project area, over the last year. These activities have been primarily associated with mining operations and mineral exploration.

Table 4-3

FALL-WINTER DEER COMPOSITION SURVEYS

Saval Project

YEAR	NUMBER OF DEER OBSERVED	NUMBER OF DEER CLASSIFIED	BUCK:DOE:FAWN RATIO	NUMBER OF GROUPS	AVERAGE GROUP SIZE	CLASSIFICATION RATE (Deer/Hour)
1978	272	272	30:100:91	28	7.5	209
1979	223	223	27:100:94	25	9	149
1980	239	235	37:100:53	26	9	141

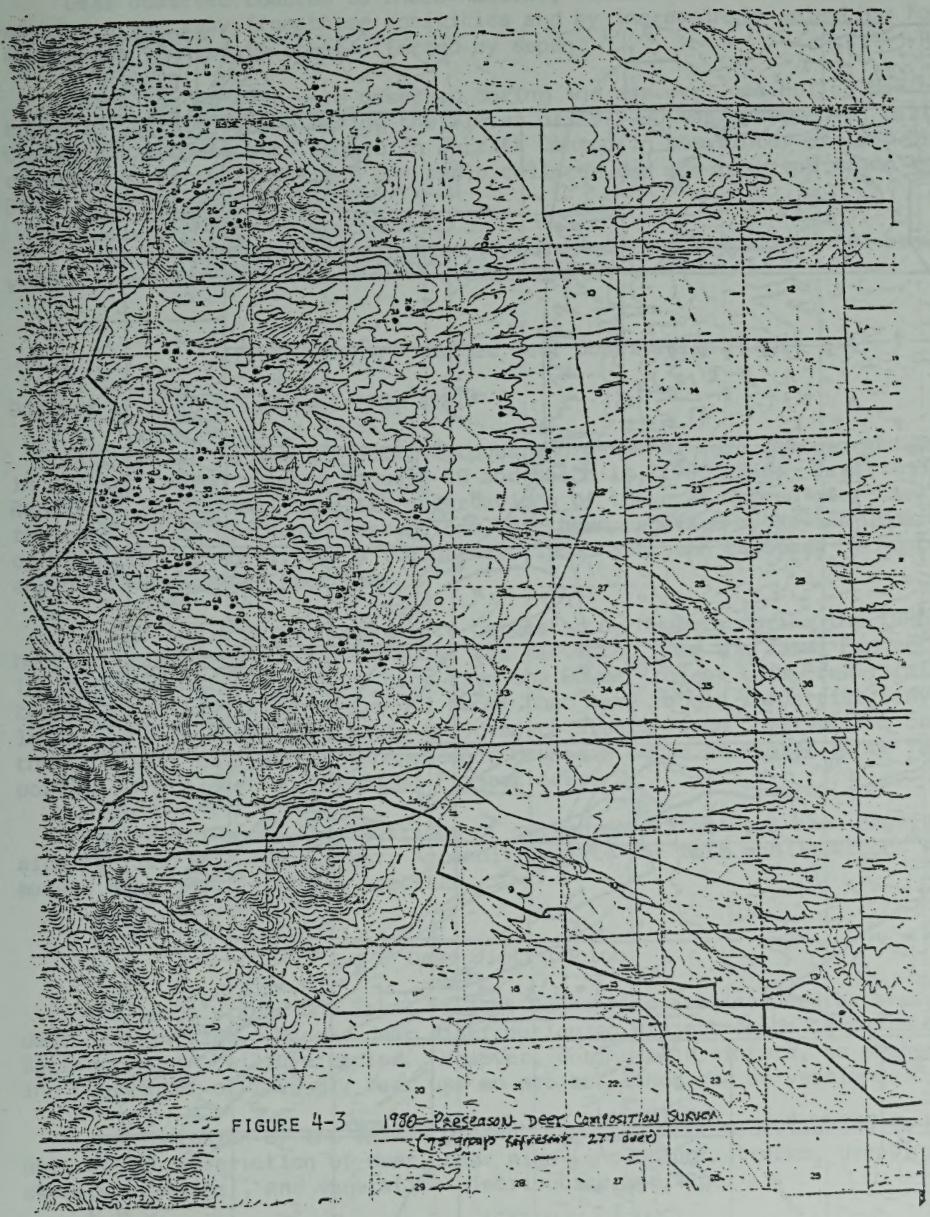

FIGURE 4-3 1980 Preseason Deer Composition Survey
(75 groups surveyed, 271 deer)

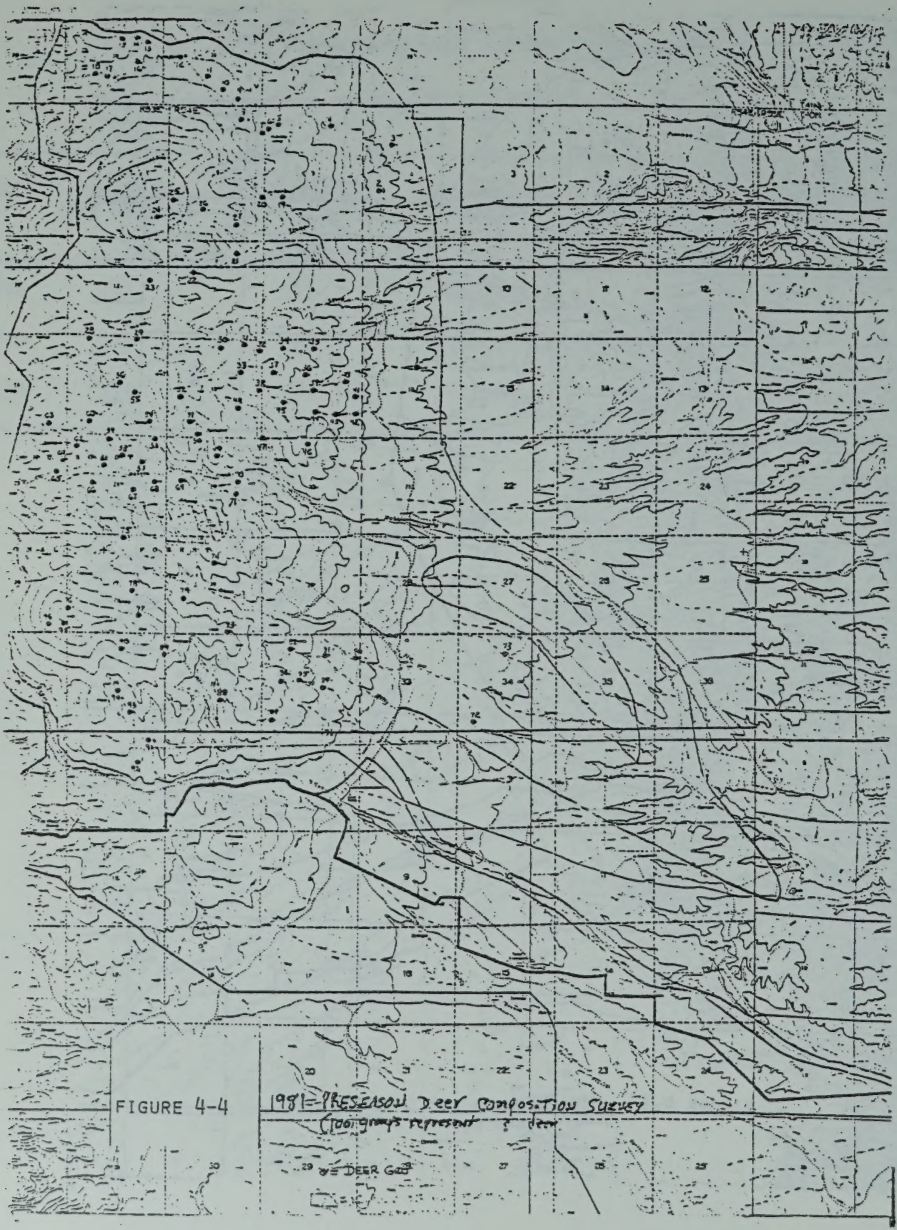
1981 PRESEASON Deer Composition Survey
(100 grids represent deer)
= DEER GRID

FIGURE 4-4

Deer observed reacted to these habitat, visual and noise disturbances by seeking areas away from these activities and by increasingly selecting for the more dense vegetative cover afforded by aspen.

Three tagged deer were observed during the survey: one belled doe captured in Jerritt Canyon during the winter of 1979-80 was observed in California Creek; one 2-point buck tagged in Jerritt Canyon in the winter of 1980-81 was observed in Gance Creek; and one radio collared doe was observed along the Sheep Creek Bench area.

A map showing deer distribution (Figure 4-3) and comparisons of previous year's survey results (Table 4-4) are attached.

Jerritt Canyon - Tagged Deer Observation-Figure 4-5

October 1, 1980 - September 30, 1981

A total of 36 deer (4 buck, 26 does and 6 fawns) were capturd and marked in Jerritt Canyon between January 30 and March 11, 1980 (See: Saval Annual Report FY 1980). All reported observations of these 36 marked deer have been recorded. Most of these observations have been reported by Nevada Department of Wildlife personnel, but a few observations have been reported by hunters and other interested sportsmen.

Two of the 4 marked bucks were harvested by hunters during the 1980 deer hunting season. One of these bucks was harvested from the Saval Project area. The reported harvest of this buck from the Saval Project (Jim Creek) raises the total to 3 deer (2 does and 1 buck) that were tagged in Jerritt Canyon and later found to have migrated to the project area. These observations confirm that the west side of the Independence Mountain serve as winter range for a portion of the deer on the Saval Project area.

Figure 4-5 shows the locations of marked deer that have been observed outside the Jerritt Canyon area. Appendix B lists the date and locations of all marked deer that have been reported.

Deer Distribution

All lands within the Saval Project boundaries are included as areas of deer distribution. Mapped deer distribution on project lands is based on a Spring through Fall use period. However, during mild winters, as observed during the winter of 1980-81, deer use on project lands can be yearlong.

The inclusion of the entire project area for deer distribution is based on: direct observation of deer, deer sign (including: tracks, droppings, and skelital remains), and vegetation distribution and type.

Table 4-4

PRESEASON DEER SURVEY RESULTS

Saval Project

Year	Number of Deer Observed	Number of Deer Classified	Buck:Doe:Fawn Ratio	Number of Groups	Average Group Size	Classification Rate (Deer/Hour)
1979	109	105	67:100:83	--	--	44
1979	202	194	46:100:90	47	4.3	72
1980	227	277	66:100:116	75	3.7	115
1981	405	359	52:100:89	100	3.9	103

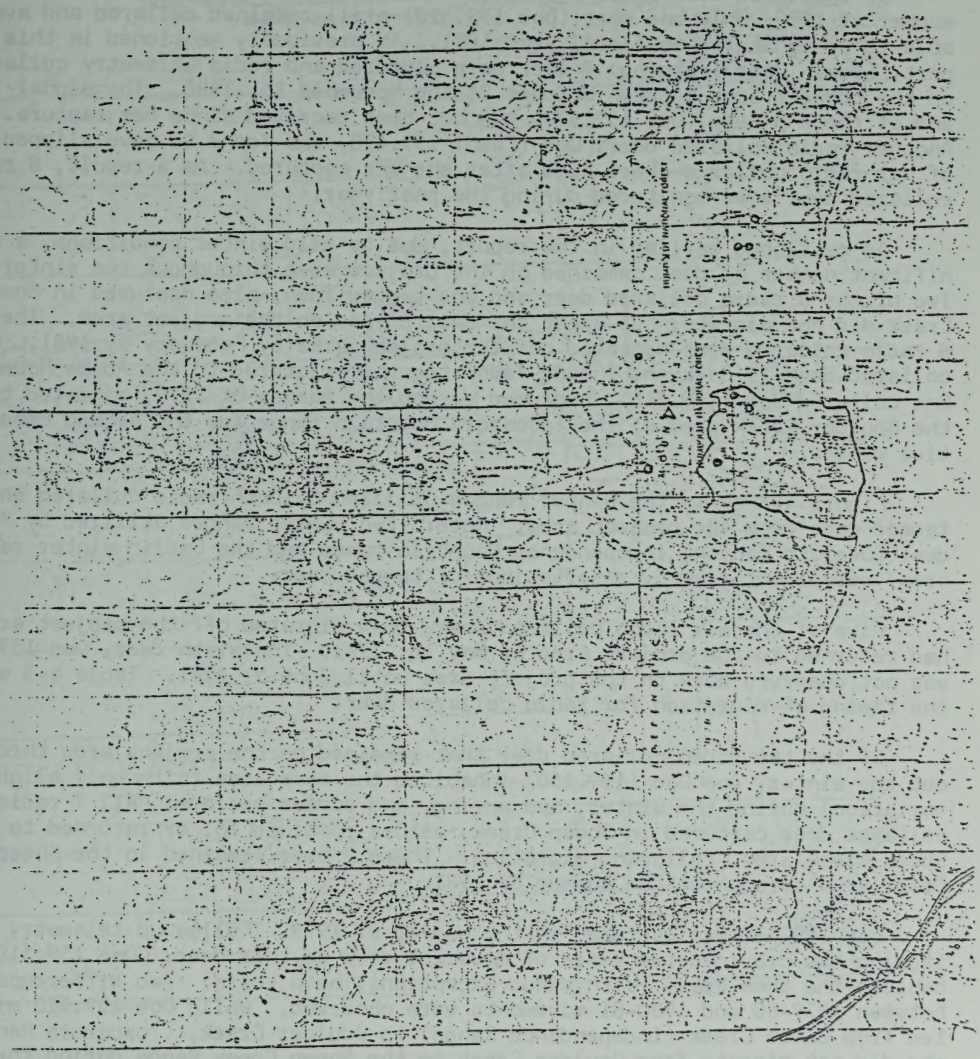

Fig. 4-5. Marked deer locations outside the Jerritt Canyon area.

Deer Telemetry Follow-up - Figures 4-6 through 4-16

Of the three deer radio telemetry collared on the project area during the summer of 1979, only one deer (Doe 159.510) still remained collared and available to be monitored in fiscal year 1981. As previously mentioned in this report, (See: Deer Trapping) 9 deer were captured and radio telemetry collared on the project area between October 25 and November 25, 1980. The signal from one of these 9 deer, Doe 159.570, has not been received since her capture. Another radio collared deer, Doe (Fawn) 159.470, was found to have slipped out of her radio collar a short time after she was captured. As a result, 8 radio collared deer were monitored during the past year.

As mentioned earlier in the report, due to mild winter conditions, a significant number of deer remained on the project area throughout the winter. Two of the 8 radio collared deer and one tagged fawn, also captured in Sheep Creek did not migrate, but spent the entire year on the project area. The other 6 radio collared deer migrated off the project area by February 3, 1981. Four collared deer (3 does and 1 buck fawn) together migrated to the Adobe Mountains. One collared Doe (159.510), captured during the summer of 1979, migrated to the Boulder Creek area of the Tuscarora Mountain range for the second consecutive winter.

Figure 4-6 shows the winter ranges utilized by both radio collared and tagged deer from the project area. Note: two winter ranges utilized by "Saval" deer (Jerritt Canyon, Independence Mountain range and the Carlin winter range area) were identified by observations of tagged deer.

Five of the six radio collared deer, that migrated off the project area, had returned to the project area by May 18, 1981. The sixth deer, Doe 159.510, was not observed back on the project area until June 9, 1981. Table 4-5 shows the timing of migration for radio collared deer.

Of the two radio collared deer that remained on the project area throughout the winter, one Doe (159.450) inhabited the same area (with only slight variation) during the winter, and spring, and summer periods. All 7 radio collared deer captured in Sheep Creek, either remained in, or returned to the Sheep Creek area, following migration. These 7 deer remained in the Sheep Creek area throughout the summer of 1981.

Doe 159.510 was captured in the summer of 1979. Follow-up telemetry monitoring has provided two years of movement data on this deer. Doe 159.510 inhabited the same areas (with minor exceptions) both years. Two differences between 1979-80 and 1980-81 movements were observed. While Doe 159.510 migrated from Gance Creek (Independence Range) to Boulder Creek, (Tuscarora Range), she did not migrate from Boulder Creek to the Sheep Creek Range during the winter of 1980-81. This lack of observed migration to the Sheep Creek Range is attributed to mild winter weather. The other difference between the two year's movements was that between August 5th and August 18, she moved 1.75 miles west along Gance Creek. Prior to this move, she had been continuously located within the same area used in 1979-80. Doe 159.510 remained at this new location through September 21, 1981. This 1.75 mile movement is believed to have resulted from dry summer conditions, which caused a lack of available water in the area previously utilized. A map (figure 4-7) showing the locations and dates of significant movements by Doe 159.510 is attached.

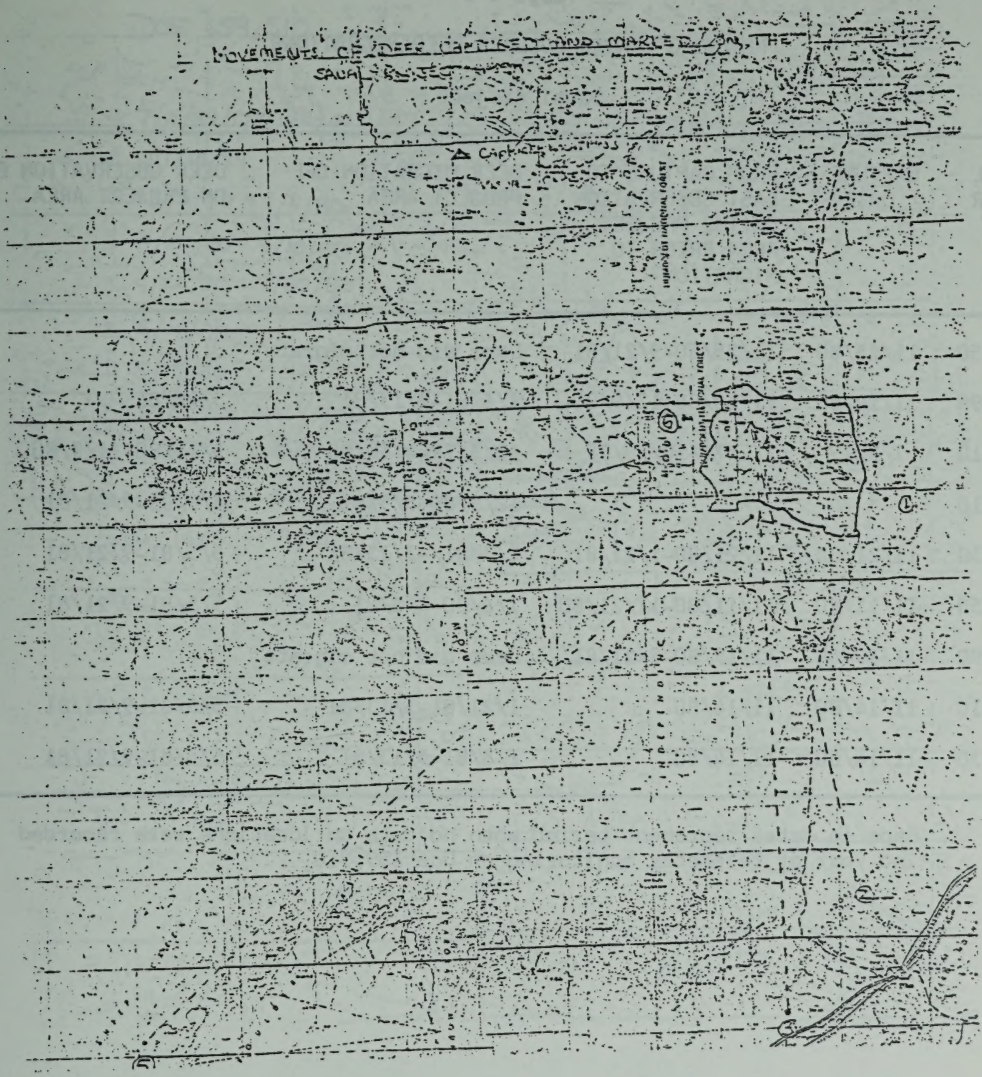

Fig. 4-6. Winter ranges utilized by radio-collared and tagged deer.

Table 4-5

TIMING OF RADIO COLLARS DEER MIGRATIONS

Saval Project

ANIMAL NUMBER	CAPTURE DATE	FROM CAPTURE TO LAST OBSERVATION ON THE PROJECT AREA PRIOR TO MIGRATION	DEER MIGRATION OFF PROJECT AREA	DEER OBSERVATION BACK ON PROJECT AREA
159.450	11/25/80	11/25/80-9/21/81	Deer did not migrate	
159.490	11/18/80	11/18/80-12/9/80	1/6/81-2/13/81	5/18/81
159.510	7/2/79	7/2/79-10/18/79	12/3/79-4/30/80	5/16/80-11/3/80
159.510	*	* *	12/9/80-5/5/81	6/9/81-9/21/81
159.530	11/21/80	11/21/80-1/21/81	2/3/81/-3/13/81	5/5/81-9/21/81
159.550	11/11/80	11/11/80-11/21/80	1/6/80-3/3/81	5/5/81-9/21/81
159.590	11/19/80	11/19/80-9/21/81	Deer did not migrate	
159.610	11/14/80	11/14/80	1/21/81-3/13/81	5/5/81-9/21/81
159.630	11/14/80	11/14/80	1/6/81-3/13/81	5/5/81-9/21/81

Gaps in dates represent period when no data on locations were recorded
*2nd year of telemetry monitoring on Doe 159.510

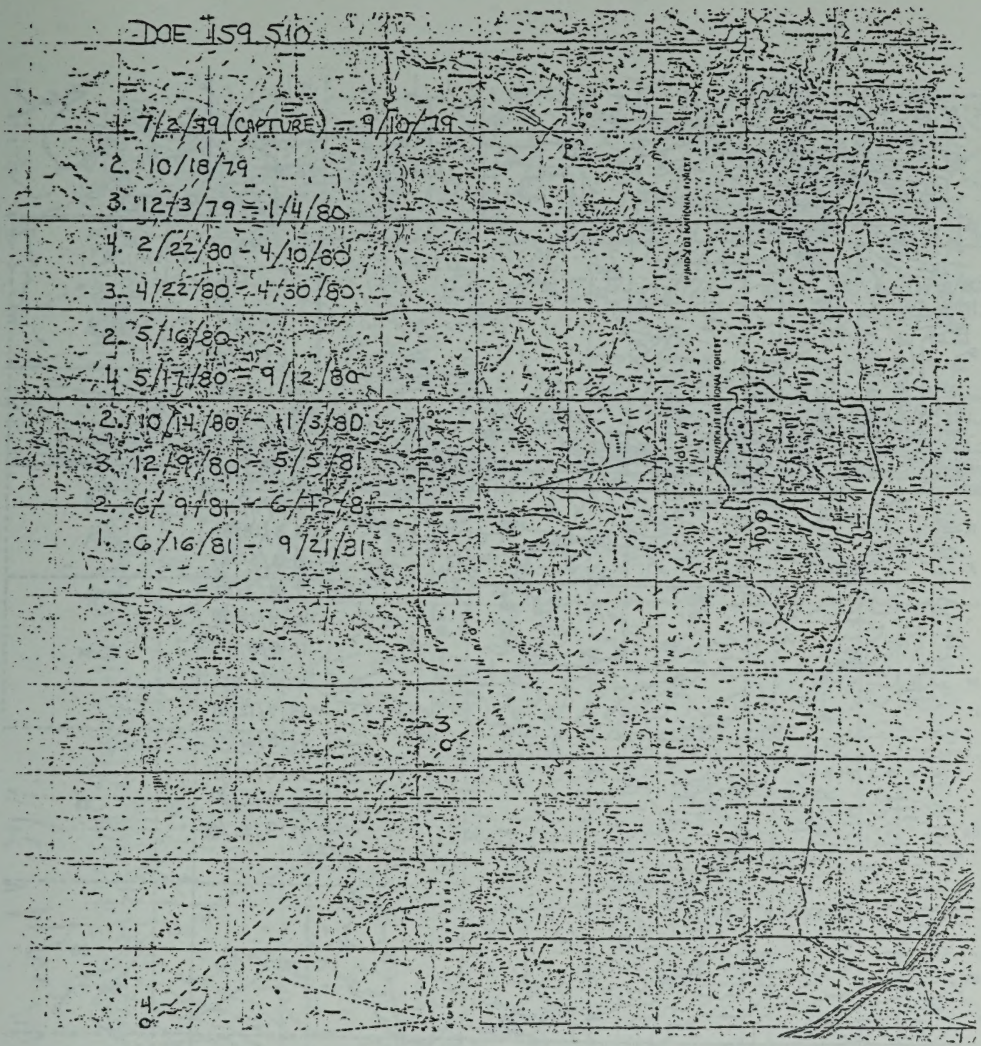

Fig. 4-7. Movements and areas occupied by doe 159.510.

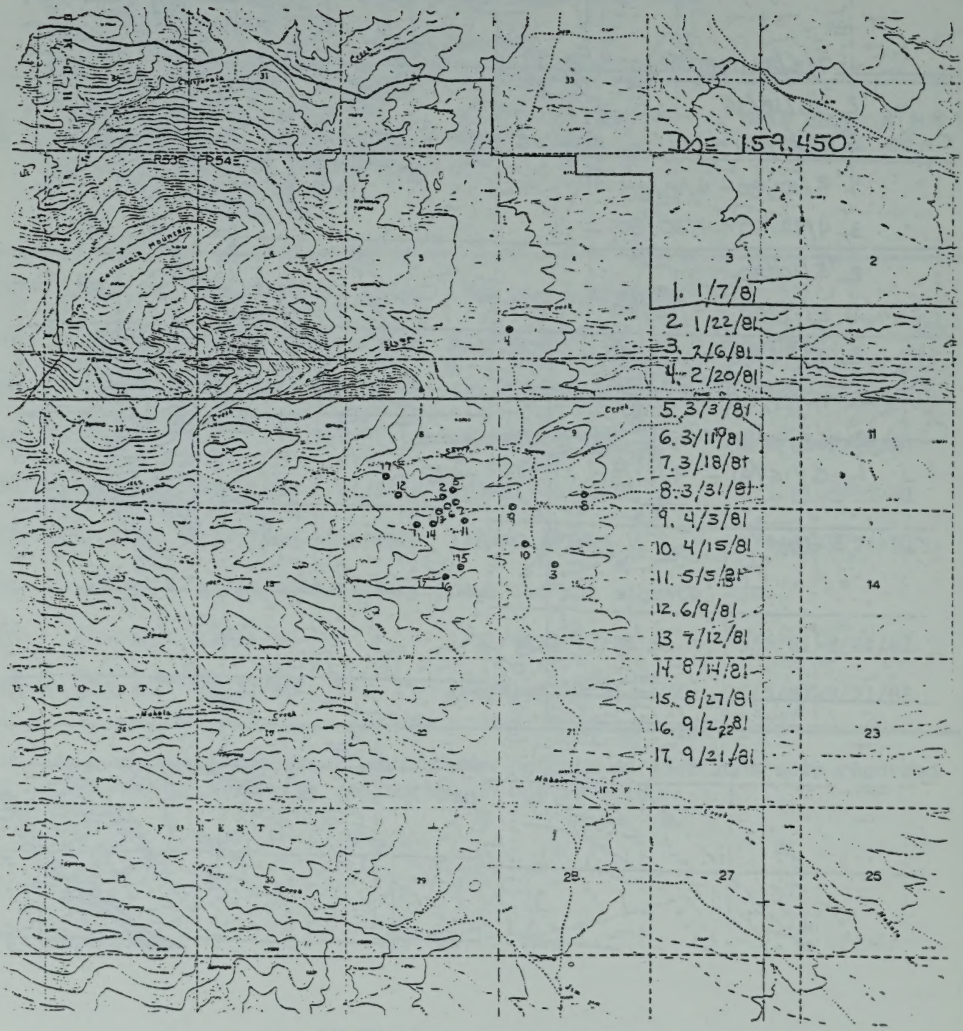

Fig 4-8. Movements of doe 159.450.

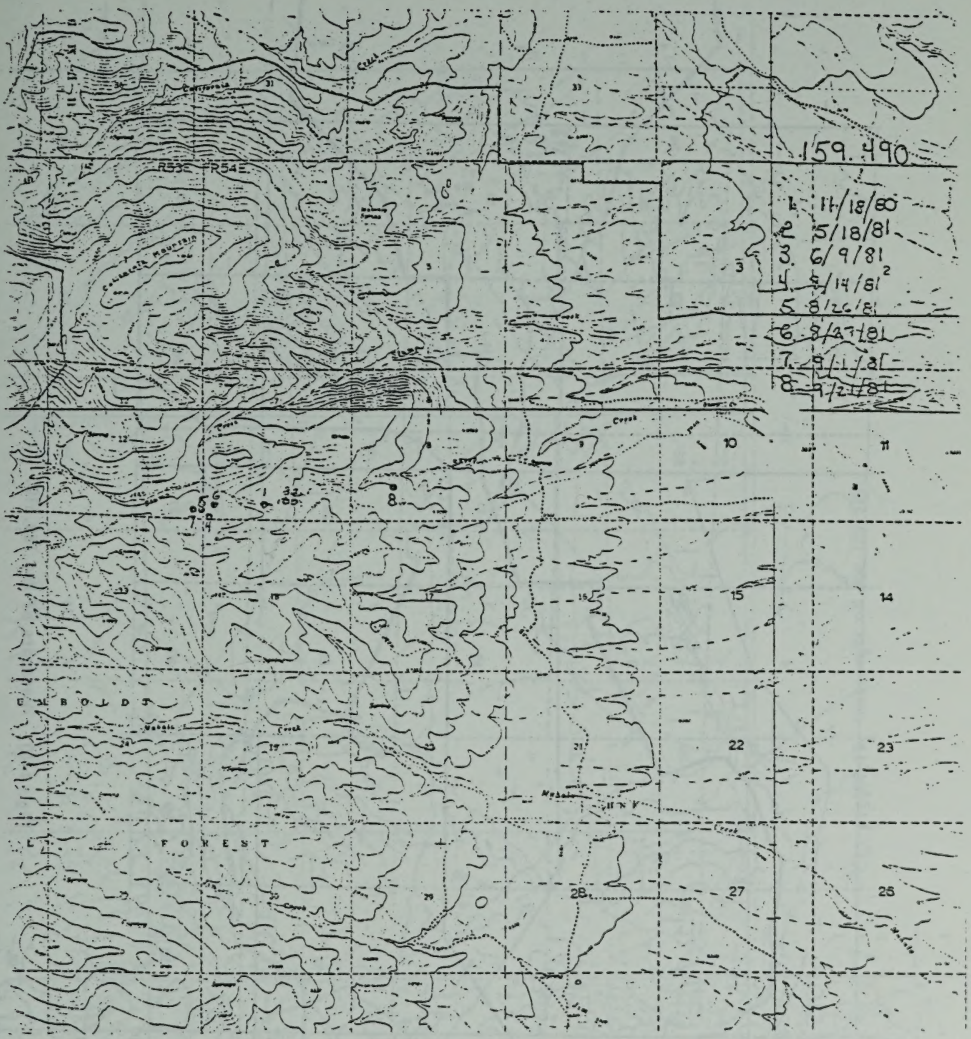

Fig. 4-9. Movements of doe 159.490.

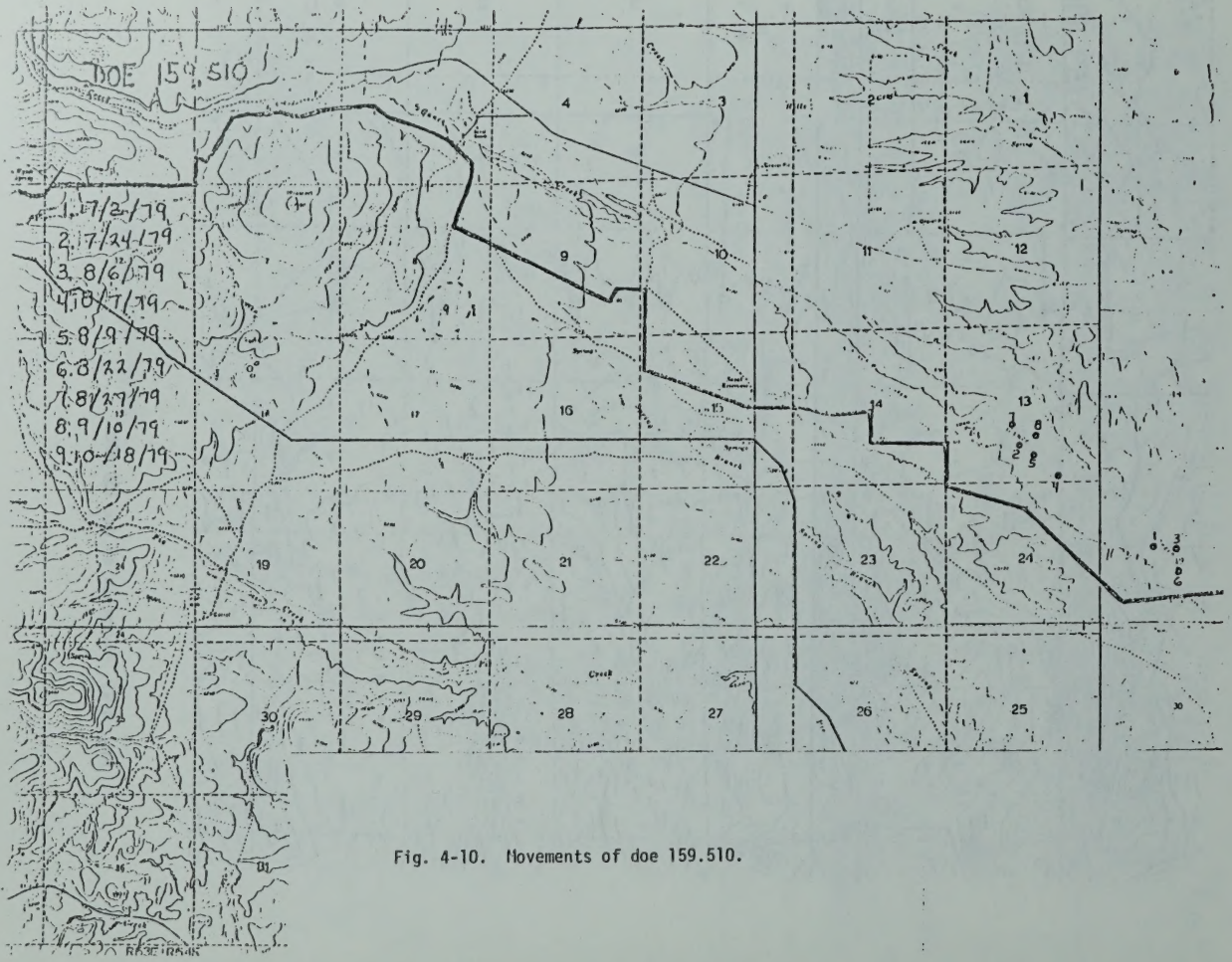

Fig. 4-10. Movements of doe 159.510.

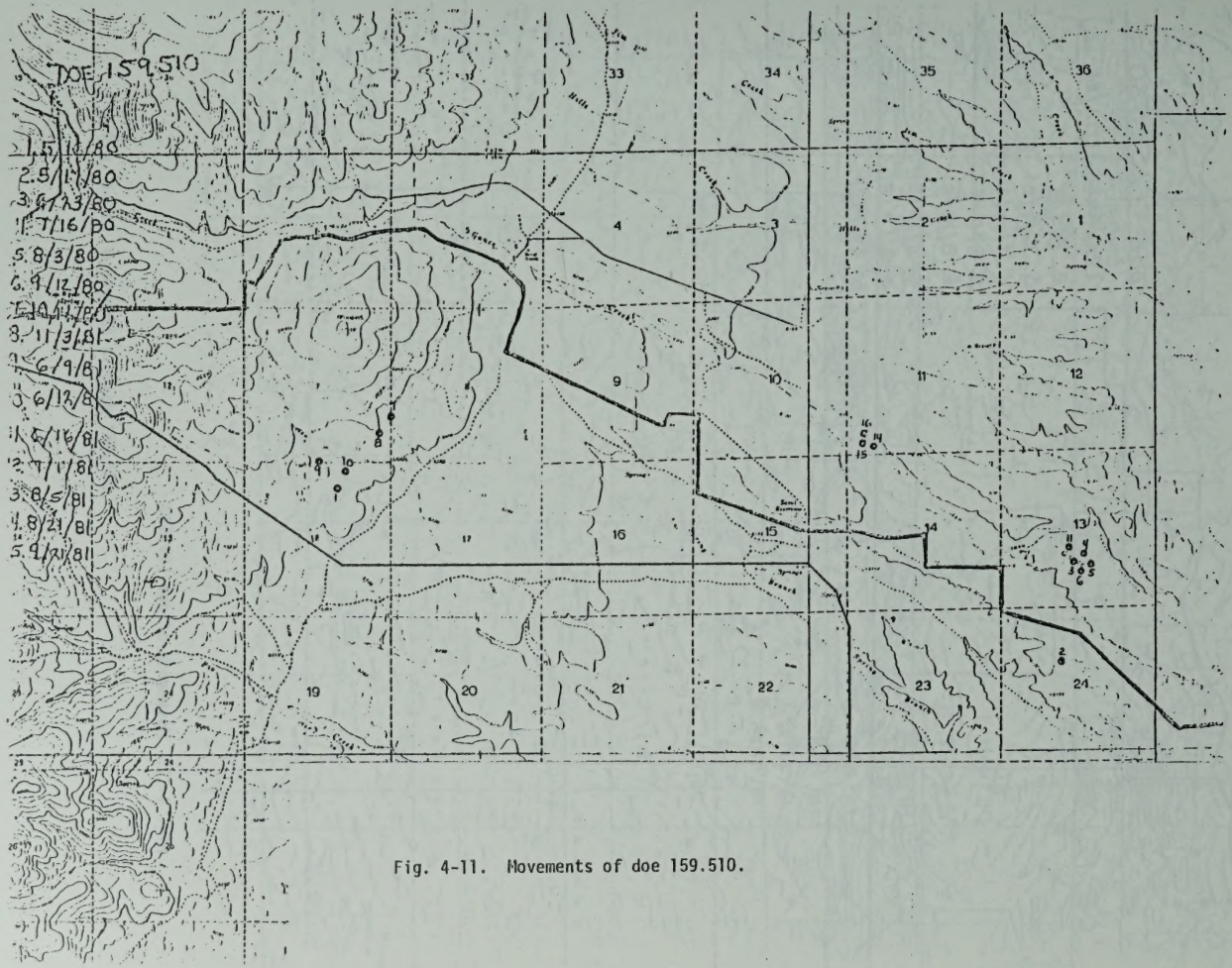

Fig. 4-11. Movements of doe 159.510.

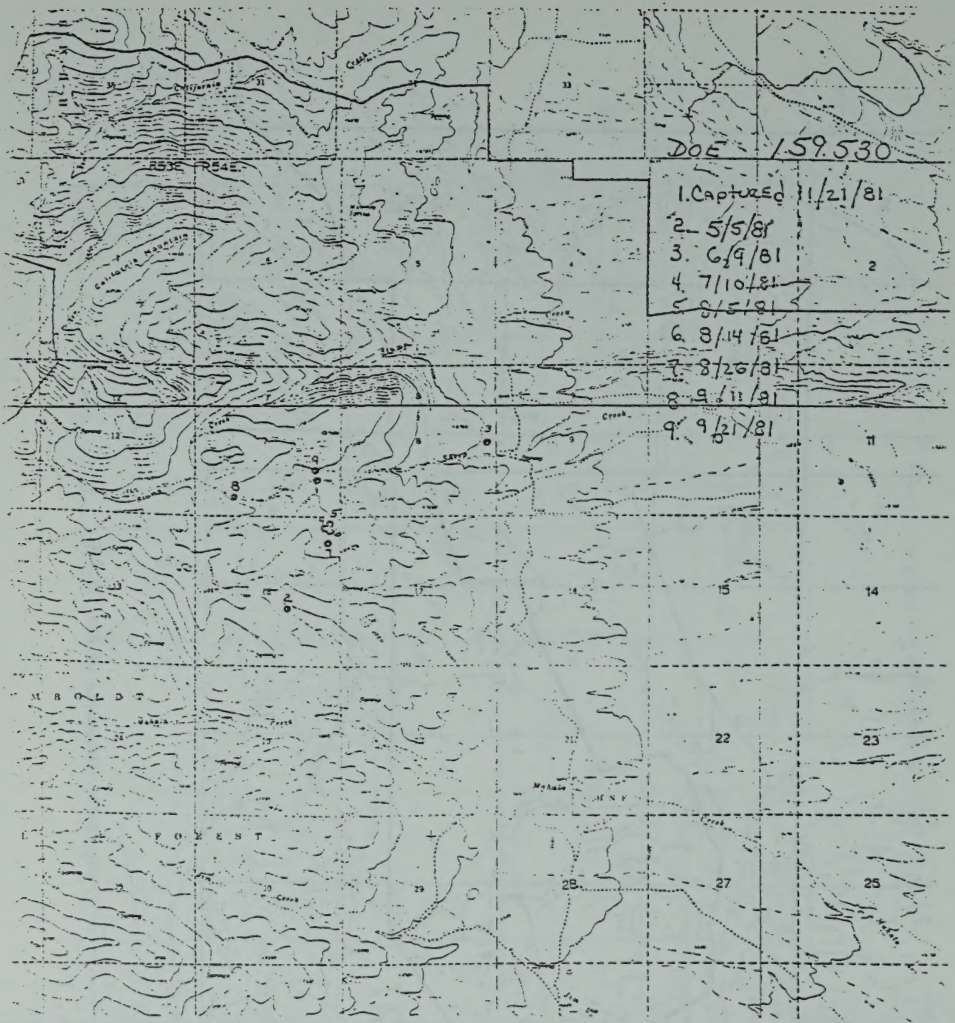

Fig. 4-12. Movements of doe 159.530.

Fig. 4-13. Movements of buck 159.550.

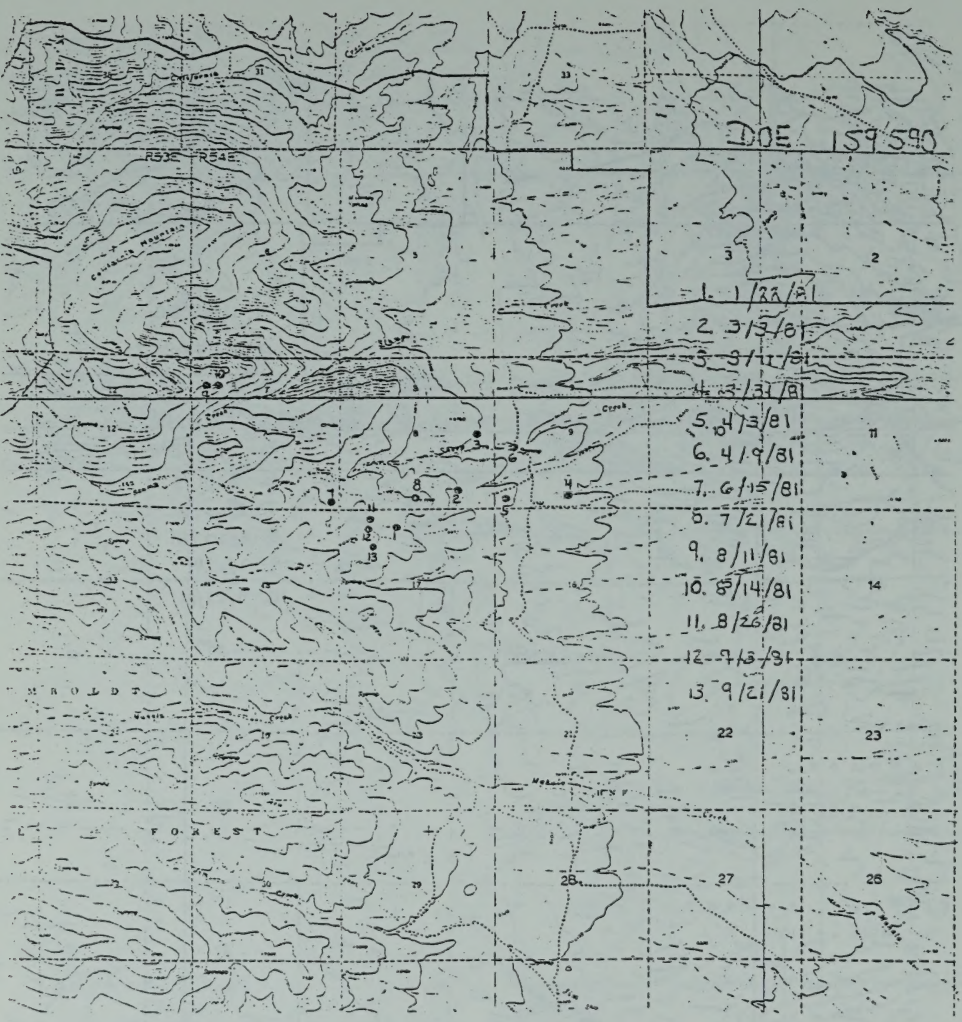

Fig. 4-14. Movements of doe 159.590.

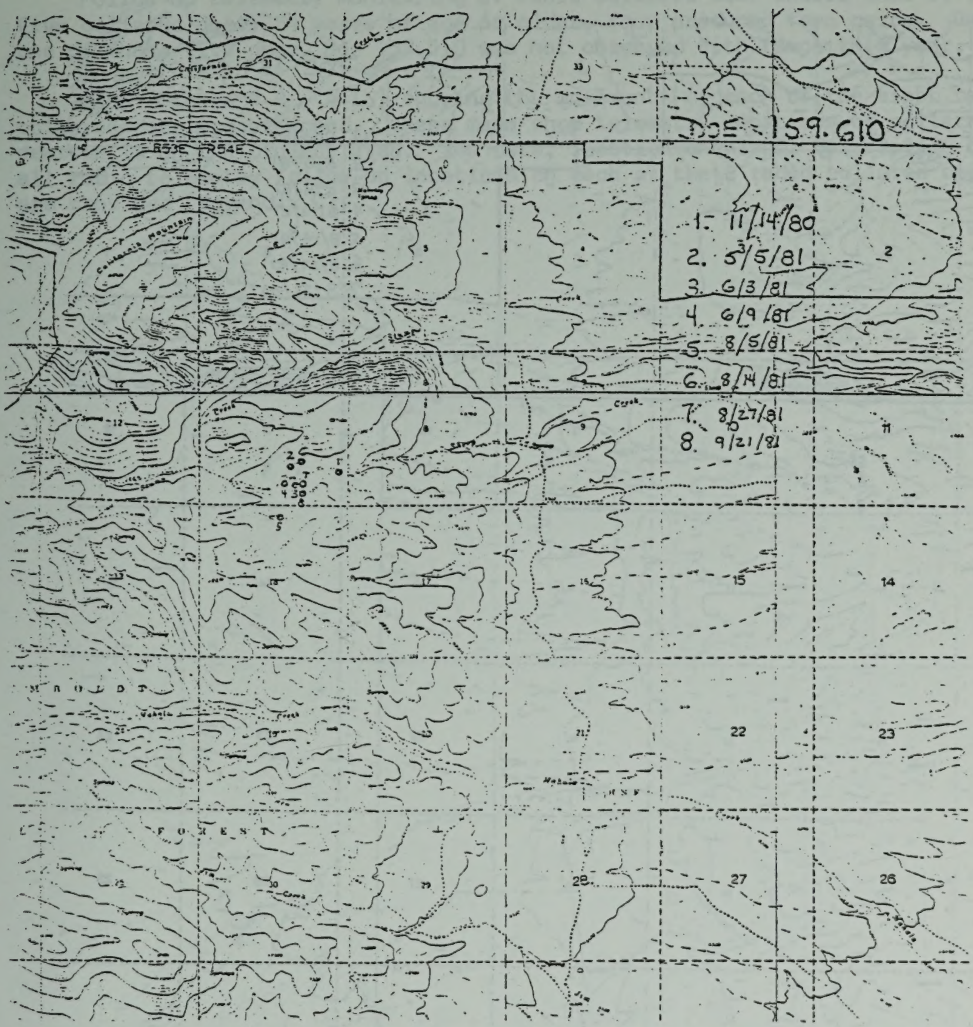

Fig. 4-15. Movements of doe 159.610.

Fig. 4-16. Movements of doe 159.630.

Follow-up telemetry monitoring of radio collared deer showed that of the five collared does, 2½ years of age or older, four produced fawn pairs. Only one of these five deer, Doe 159.510 was not observed with fawns this year.

Maps (Figure 4-8 - 4-16) showing the movements of each of the eight radio collared deer are attached. These maps show telemetry locations of collared deer while on the project area. The date, location and legal description of all radio telemetry follow-up locations on each of the 8 radio collared deer are provided (Appendix C).

APPENDIX A

TRAPPING AND TAGGING FORM 253

NEVADA DEPARTMENT OF WILDLIFE — DIVISION OF GAME — Form 253

POPULATION STUDY
Trapping and Tagging

Management Area 06 : Saval — Unit: 062 — Year: 1980 — Page 1 of 2

Date	Animal No.	Sex	Age	Tag Numbers Left	Tag Numbers Right	Wt.	Pnts.	Blood Sample	Retrap Prev. Year	T-Lok	Telemetry	Condition
11/11		F	Fawn	2859	2860	---				1	159.470	Good
11/11		M	Fawn	2861	2862	---				2	159.550	Good
11/12		M	Fawn	2863	2864	80				3	None	Good
11/14		M	Fawn	2865	2866	65				4	None	
11/14		F	5	2867	2868	130				5	159.610	
11/14		M	Fawn	2869	2870	65				6	None	
11/14		F	4	2871	2872	130				7	159.630	
11/15		F	Fawn	2875	2876	60				8	None	Cut on Head
11/18		F	4	2873	2874	130				9	159.490	
11/18	Recaptured Doe											
11/18	Recaptured Doe											

POPULATION STUDY
Trapping and Tagging

Management Area 06 : Saval Unit: 062 Year: 1980 Page 2 of 2

Date	Animal No.	Sex	Age	Tag Numbers Left	Right	Wt.	Pats.	Blood Sample	Retrap Prev.Year	T-Lok	Telemetry	Condition
11/19		M	Fawn	2649	2650	80				10	None	
11/19		F		2651	2652	130				12	159.590	
11/19		F	1 1/2	MORTALITY BROKEN NECK								
11/19		RECAPTURED DOE - 9 -LOST ONE EAR TAG										
11/20		F	2 1/2	2653	2654	----				13	159.570	
11/21		F	5	2655	2656	---				14	159.530	
11/21		RECAPTURED FAWN										
11/25		F	1 1/2	2659	2660					18	159.450	
11/25		RECAPTURED DOE										

APPENDIX B

TAGGED DEER OBSERVATION

JERRITT CANYON - TAGGED DEER OBSERVATIONS

DATE	ANIMAL NUMBER	LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.	REMARKS
9/25/80	Belled Doe	T41N R53E Sec 36	Independence Range, California Ck.	Observed during pre-season deer survey by Delaney (NDOW) in Saval Project Area.
9/25/80	Belled Doe	T40N 54E Sec 5	Independence Range, Mahoney Springs	
10/5/80	Belled Doe	T42N R52E Sec 7	Independence Range, Peterson Ck. (Upper)	Reported by deer hunter to NDOW personnel at Mt. City ckeck station.
10/26/80	Tagged Buck #38-T Lok	T40N R53E Sec 23	Independence Range, Jim Creek (Upper)	Harvested during general rifle season as a 2pt. check at Elko HQ NDOW by Wickersham.
11/1/80	5 Belled/ Trapped Deer	T40N R53E -----	Independence Range, Jerritt Canyon	Reported by hunters contact by NDOW personnel at Mt. City Hwy. check station.
11/1/80	Tagged Buck #21-T Lok	T40N R53E -----	Independence Range, Jerritt Canyon	Harvest during general Rifle season as a 3x3 by hunger contact at Mt. City Hwy. check station.
11/24/80	Belled Doe	T40N R53E Sec 19	Independence Range, Upper Burns Bench	Reported by racher (Van Norman) Deer observed for several days in that area.
11/24/80	1 Belled Doe	T40N R53E Sec 3	Independence Range, Jerritt Canyon	Observed by NDOW personnel while conducting Fall Deer surveys.
11/24/80	1 Belled Doe	T40N R53E Sec 4	Independence Range, Jerritt Canyon	Observed by NDOW personnel while conducting Fall Deer surveys.
12/11/80	Belled Doe	T40N R54E Sec 5	Independence Range, Mahoney Springs	Observed during post season deer survey by Delaney (NDOW) on the Saval Project Area.

JERRITT CANYON - TAGGED DEER OBSERVATIONS (con't)

DATE	ANIMAL NUMBER	LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.	REMARKS
3/23/81	3 Belled Does	T40N R53E Sec 5	Independence Range, Jerritt Canyon	Observed during spring deer surveys by NDOW personnel.
3/23/81	1 Yellow-ear tagged deer	T40N R53E Sec 4	Independence Range, Jerritt Canyon	Observed during spring deer surveys by NDOW personnel.
3/23/81	Belled Doe	T41N R53E Sec 33	Independence Range, Jerritt Canyon	Observed during spring deer surveys by NDOW personnel.
3/23/81	2 Belled Does	T40N R53E Sec 3	Independence Range, Jerritt Canyon	Observed during spring deer surveys by NDOW personnel.
3/23/81	2 Belled Does and 1 yellow ear tagged deer	T40N R43E Sec 6	Independence Range, Jerritt Canyon	Observed during spring deer surveys by NDOW personnel.
3/23/81	1/ Belled Doe and 1 yellow ear tagged deer	T41N R53E Sec 19	Independence Range, March Cr. (Bench)	Observed during spring deer survey by NDOW personel.
4/9/81	Belled Doe	T41N R52E Sec 11	Independence Valley	Reported by Terry Thompson (U.P.S. Delivery Person).
5/1/81	2 Belled Does	T43N R54E Sec 32	Independecne Range, (Mounth N. Fork Canyon	Reported by Wayne Testolin (water resources).
8/8/81	Belled Doe	T40N R53E -----	Independence Range, Jerritt Canyon	Reported by Greg Rost (U.S. Fish and Wildlife Service).
8/27/81	Belled Doe	T42N R54E Sec 8	Independence Range, Peterson Creek	Reported by Wayne Testolin (water resources).
10/6/81	Belled Doe	T41N R53E Sec 36	Independence Range, California Creek	Observed during preseason deer survey by NDOW on the Saval Project area.
10/17/81	2 Bell Does	T43N R54E Sec 32	Independence Range (mouth) N. Fork Can.	Observed by Bob Layton (NDOW personnel).

APPENDIX C

TELEMETRY DEER FOLLOW-UP

Saval Project

TELEMETRY DEER FOLLOW-UP

DOE 159.450

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured) 11/25/80	T40N,R54E Sec 7	Independence Range, Sheep Creek
12/09/80	T40N,R54E Sec 16	Independence Range, Sheep-Mahala Creek Bench
01/07/81	T40N,R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
01/22/81	T40N, R54E Sec 8	Independence Range, Sheep-Mahala Creek Bench
02/06/81	T40N, R54E Sec 16	Independence Range, Sheep-Mahala Creek Bench (Low)
02/20/81	T40N, R54E Sec 4	Independence Range, Stump Creek Bench
03/03/81	T40N, R54E Sec 8	Independence Range, Sheep-Mahala Creek Bench
03/11/81	T40N, R54E Sec 8	Independence Range, Sheep-Mahala Creek Bench
03/18/81	T40N, R54E Sec 8	Independence Range, Sheep-Mahala Creek Bench
03/31/81	T40N, R54E Sec 9	Independence Range, Sheep Creek Bench (low)
04/03/81	T40N, R54E Sec 9	Independence Range, Sheep Creek Bench
04/15/81	T40N, R54E Sec 16	Independence Range, Sheep Mahala Creek Bench (Low)
05/05/81	T40N, R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
06/09/81	T40N, R54E Sec 8	Independence Range, Sheep Creek
07/12/81	T40N, R54E Sec 8	Independence Range, Sheep-Mahala Creek Bench
08/01/81	T40N, R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
08/27/81	T40N, R54E Sec 17	Independence Range, small drainage in Sheep-Mahala Bench area
09/02/81	T40N, R54E Sec 17	Independence Range, small drainage in Sheep-Mahala Bench area
09/21/81	T40N, R54E Sec 17	Independence Range, Sheep Creek

Saval Project

TELEMETRY DEER FOLLOW-UP

DOE 159.490

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured)		
11/19/80	T35N R55E Sec 7	Independence Range
12/09/80	T35N R55E Sec 6	Adobe Range
01/06/80	T35N R55E Sec 6	Adobe Range
01/21/81	T35N R55E Sec 7	Adobe Range
02/03/81	T35N R55E Sec 6	Adobe Range
02/20/81	T35N R55E Sec 6	Adobe Range
03/13/81	T35N R55E Sec 6	Adobe Range
05/18/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
06/09/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
08/14/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
08/26/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
09/01/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
09/21/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek

Saval Project

TELEMETRY DEER FOLLOW-UP

DOE 159.510

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured) 07/02/79	T39N R55E Sec 19	Lower Gance Creek (Jungle Meadow)
07/24/79	T39N R54E Sec 13	Lower Gance Creek (Jungle Meadow)
08/06/79	T39N R55E Sec 19	Lower Gance Creek (Jungle Meadow)
08/09/79	T39N R54E Sec 13	Lower Gance Creek (Jungle Meadow)
08/22/79	T39N R54E Sec 19	Lower Gance Creek (Jungle Meadow)
08/27/79	T39N R54E Sec 13	Lower Gance Creek (Jungle Meadow)
09/10/79	T39N R54E Sec 13	Lower Gance Creek (Jungle Meadow)
10/18/79	T39N 54E Sec 8	Prospect Peak Bench
12/03/79	T37N 250E Sec 21	Tuscarora Range, (Upper) Boulder Creek
12/04/79	T37N 250E Sec 28	Tuscarora Range, Boulder/Bell Creek
12/07/79	T37N 250E Sec 28	Tuscarora Range, Boulder/Bell Creek
12/10/79	T37N 250E Sec 28	Tuscarora Range, Boulder/Bell Creek
12/20/79	T37N 250E Sec 28	Tuscarora Range, Boulder/Bell Creek
12/31/79	T37N 250E Sec 28	Tuscarora Range, Boulder/Bell Creek
01/04/80	T37N 250E Sec 28	Tuscarora Range, Boulder/Bell Creek
[illegible]	T34N R47E Sec 32	Sheep Creek Range
03/14/80	T34N R47E Sec 32	Sheep Creek Range
03/20/80	T34N R47E Sec 32	Sheep Creek Range
04/10/80	T34N R47E Sec 32	Sheep Creek Range
04/22/80	T37N R50E Sec 28	Tuscarora Range, Boulder/Bell Creek
04/30/80	T37N R50E Sec 28	Tuscarora Range, Boulder/Bell Creek
05/15/80	T39N R54E Sec 7	Prospect Peak (South slope)
05/16/80	T39N R54E Sec 7	Prospect Peak (South slope)
05/17/80	T39N R54E Sec 2	Lower Gance Creek area
06/23/80	T39N R54E Sec 13	Lower Gance Creek area
07/16/80	T39N R54E Sec 13	Lower Gance Creek area

TELEMETRY DEER FOLLOW-UP

Saval Project

(Doe 159.510)

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured)		
08/03/80	T39N R54E Sec 13	Lower Gance Creek
09/12/80	T39N R54E Sec 13	Lower Gance Creek
10/14/80	T39N R54E Sec 7	Prospect Peak (South Slope)
11/03/80	T39N R54E Sec 7	Prospect Peak (South Slope)
11/12/80	T39N R52E Sec 7	Taylor Canyon Summit Area
12/09/80	T37N R50E Sec 28	Tuscarora Range, Boulder/Bell Creek
01/06/81	NO SIGNAL	Received
02/03/81	T37N R50E Sec 28	Tuscarora Range, Boulder/Bell Creek
02/20/81	NO SIGNAL	Received
03/13/81	NO SIGNAL	Received
05/05/81	T37N R50E Sec 28	Tuscarora Range, Boulder/Bell Creek
06/09/81	T39N R54E Sec's 7-18 (between)	Prospect Peak (South Slope area)
06/12/81	T39N R54E Sec 18	Prospect Peak (South Slope area)
06/16/81	T39N R54E Sec 13	Lower Gance Creek (Jungle Meadow)
07/01/81	T39N R54E Sec 13	Lower Gance Greek (Jungle Meadow)
08/05/81	T39N R54E Sec 13	Lower Gance Creek (Jungle Meadow)
08/21/81	T39N R54E Sec 11	Lower Gance Creek
09/02/81	T39N R54E Sec 11	Lower Gance Creek
09/11/81	T39N R54E Sec 11	Lower Gance Creek

TELEMETRY DEER FOLLOW-UP

Saval Project

DOE 159.530

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured)		
11/21/80	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
12/09/80	T40N R54E Sec 5	Independence Range, (mouth) Stump Creek
01/06/81	T40N R54E Sec 8	Independence Range, Sheep Creek Bench
02/03/81	T39N R53E Sec's 3 or 4	Just South of Humboldt River
02/20/81	T39N R53E Sec's 3 or 4	Just South of Humboldt River
03/13/81	T39N R53E Sec's 3 or 4	Just South of Humboldt River
05/05/81	T40N R54E Sec 18	Independence Range, (Upper) Mahala Creek
06/09/81	T40N R54E Sec 8	Independence Range (mouth) Sheep Creek
07/10/81	T40N R54E Sec 18 NE ¼, NE ¼	Independence Range, Sheep Creek
08/05/81	T40N R54E Sec 18 NE ¼, NE ¼	Independence Range, Sheep Creek
08/14/81	T40N R54E Sec 18 NE ¼, NE¼	Independence Range, Sheep Creek
08/26/81	T40N R54E Sec 18 NE ¼, NE ¼	Independence Range, Sheep Creek
09/11/81	T40N R54E Sec 7	Independence Range, (Upper) Sheep Creek
09/21/81	T40N R54E Sec 7	Independence Range, (Upper) Sheep Creek

Saval Project

TELEMETRY DEER FOLLOW-UP

DOE 159.630

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK ETC.
(Captured) 11/14/80	T40N R54E Sec 7	Independence Range, Sheep Creek
01/05/81	T35N R54E Sec 12	Adobe Range, Cherry Spring Area
01/21/81	T35N R55E Sec 5	Adobe Range
02/03/81	T35N R55E Sec 6 W1/2	Adobe Range
02/20/81	T35N R54E Sec 2 SE1/4	Adobe Range
03/13/81	T35N R55E Between Sec 7&8	Adobe Range, Kittridge Canyon
05/05/81	T40N R54E Sec 7	Independence Range, Sheep Creek (Upper)
06/09/81	T40N R54E Sec 7	Independence Range, Sheep Creek (Upper)
08/10/81	T40N R54E Sec 7	Independence Range, Sheep Creek (Upper)
08/14/81	T40N R54E Sec 7	Independence Range, Sheep Creek (Upper)
08/27/81	T40N R54E Sec 7	Independence Range, Sheep Creek (Upper)
09/21/81	T40N R54E Sec 7	Independence Range, Sheep Creek (Upper)

TELEMETRY DEER FOLLOW-UP

Saval Project

BUCK (Fawn) 159.550

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured)		
11/11/80	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
01/06/81	T35N R55E Sec 6	Adobe Range
01/21/81	T35N R55E Sec 7	Adobe Range, Ridgeline at uppermost Kittridge Canyon
02/03/81	T35N R55E Sec 6 W ½	Adobe Range
02/20/81	T35N R55E Sec's 7,8,17, and 18 (junctions)	Adobe Range, Kittridge Springs Area
03/03/81	T35N R55E Between central Sec 7 and 8	Independence Range, (Upper) Mahala Creek
05/05/81	T40N R53E Sec 13	Independence Range, (Upper) Mahala Creek
06/09/81	T40N R53E Sec 13	Independence Range, (Upper) Mahala Creek
06/09/81	T40N R55E Sec 13	Independence Range (Upper) Mahala Creek
07/10/81	T40N R54E Sec 7	Independence Range, (Upper) Sheep Creek
08/05/81	T40N R54E Sec 7	Independence Range, (Upper) Sheep Creek
08/14/81	T40N R54E Sec 18 NW ¼, NW ¼	Independence Range, (Upper) Sheep Creek
08/26/81	T40N R54E Sec 18 NW ¼, NW ¼	Independence Range, (Upper) Sheep Creek
08/27/81	T40N R54E Sec 18 NW ¼, NW ¼	Independence Range, (Upper) Sheep Creek
09/27/81	T40N R54E Sec 18 NW ¼, NW ¼	Independence Range, (Upper) Sheep
09/21/81	T40N R54E Sec 7 SE ¼, SE ¼	Independence Range, (Upper) Sheep Creek

Saval Project

TELEMETRY DEER FOLLOW-UP

DOE 159.590

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured) 11/19/80	T40N R54E Sec 7	Independence Range, Sheep Creek
12/09/80	T40N R54E Sec 8	Independence Range, Sheep Creek
01/06/81	T40N R54E Sec 8	Independence Range, Sheep Creek
01/22/81	T40N R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
02/03/81	T40N R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
02/06/81	T40N R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
02/20/81	T40N R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
03/03/81	T40N R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
03/11/81	T40N R54E Sec 17	Independence Range, Sheep-Mahala Creek Bench
03/31/81	T40N R54E Sec 9	Independence Range, Sheep Creek Bench (Low)
04/03/81	T40N R54E Sec 9	Independence Range, Sheep Creek Bench (Low)
04/23/81	T40N R54E Sec 9	Independence Range, Spring at mouth of Sheep Creek
06/09/81	T40N R54E Sec 18	Independence Range, Ridgeline Sheep-Mahala Creek
06/16/81	T40N R54E Sec 8	Independence Range, Sheep Creek
[illegible]	T40N R54E Sec 8	Independence Range, Sheep Creek
[illegible]	T40N R54E Sec 7	Independence Range, Middle Stump Creek
08/20/81	T40N R54E Sec 7	Independence Range, Middle Stump Creek
09/03/81	T40N R54E Sec 17	Independence Range, Sheep Creek
09/21/81	T40N R54E Sec 17	Independence Range, Sheep Creek

Saval Project

TELEMETRY DEER FOLLOW-UP

DOE 159.610

DATE	LEGAL LOCATION	MOUNTAIN RANGE, DRAINAGE, CREEK, ETC.
(Captured) 11/14/80	T40N R54E Sec 7	Independence Range, Sheep Creek
01/21/80	T35N R55E Sec 7SW1/4	Adobe Range
02/03/81	T35N R55E Sec 6 W1/2	Adobe Range
02/20/81	T35N R55E Junction Sec's 6,7 17 & 18	Adobe Range, Kittridge Springs
03/13/81	T35N R55E Between Sec's 7&8	Adobe Range, Kittridge Canyon
05/05/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
06/03/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
06/09/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
08/05/81	T40N R54E Sec 18	Independence Range, Upper Sheep Creek
08/14/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
08/27/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek
09/21/81	T40N R54E Sec 7	Independence Range, Upper Sheep Creek

1981 Objectives:

The primary objective of nongame wildlife research at the Saval Ranch is to determine population responses of wildlife to vegetation changes brought about by livestock grazing management systems and range improvements. Specifically, data was gathered during 1981 (and will be in 1982 - 1983) for the purpose of providing a "pre-system" data base with which to compare data collected after the management plan is implemented (beginning in 1984). Upon recommendation of the Steering Committee, emphasis has been placed on monitoring responses of rodents and birds.

1981 Accomplishments:

Nongame research was divided into two categories: (1) key animal communities, and (2) representative species. Sampling of animal communities in important range sites was done for the purpose of detecting the sometimes subtle changes in rodent and bird species diversity and relative densities that often result from habitat change. This type of sampling also served to indicate whether the representative species chosen for more intensive study were as important as originally thought, or whether other species might be more responsive to the grazing system. "Representative species" were chosen on the basis of sensitivity to vegetation change (i.e., "indicator" potential), food chain niche, ease of sampling, or any combination of these considerations. Emphasis was placed on key animal communities during the 1981 field season.

Range sites referred to in this report were based on soil, vegetation composition, and precipitation zone (abbreviated hereafter as "p.z.") as mapped by SCS on the study area in 1978. Vegetative descriptions of these range sites are available in the vegetation progress report.

Methods

Rodents:

The specific objective of this research phase was to determine species composition and density of rodents in important range sites. Range sites were sampled for four consecutive nights with the live traps set out in grids of various shapes and sizes based on the habitat being trapped. When possible, square grids of 100 traps (with 50 ft. between traps) were used.

Traps were baited with rolled oats and checked twice daily (morning and evening). All animals caught were ear-tagged, sexed, weighed, and released. The relative abundance of rodents at each site was determined by regressing the daily recapture rate on the number previously caught. These abundance estimates were then converted to density estimates by dividing by the area trapped. Areas trapped for each grid and species were computed from this formula:

$$A = \pi r^2 + lw + 2rl,$$

where A = area trapped, r = average distance moved by the species being estimated (as determined from recaptures), l = length of the grid and w = width of the grid.

Birds:

The specific objective of bird population sampling was to determine the diversity and relative abundance of birds in major range sites. These transects were of two types: (1) walked, and (2) driven. Both types of transects were conducted beginning at sunrise for three consecutive days, and consisted of five-minute stops at 10 variable circular plots 0.3 mi apart, during which time all birds seen and heard were recorded. Area sampled (for density calculations) for each plot will be eventually determined by averaging the detection distances for individuals of each species. Driven transects were conducted along two roads which cross the BLM pastures of the study area (one in a north-south direction and the other in an east-west direction). These transects pass through several range sites in three of the rest-rotation pastures, and should eventually indicate any major changes in bird populations brought about by the grazing system.

Five key bird species were chosen for special consideration. These included three shrub-nesting birds (Brewer's sparrows, sage thrashers, and yellow warblers), and two ground-nesters (meadowlarks and vesper sparrows). During May and June, nest searches were conducted for these birds along transects 1 mi long and 66 feet wide. Nests were located by closely investigating the original location of flushing adults. We marked nest sites with flagging and recorded location, bird species, and number of eggs or juveniles.

Jackrabbits:

The specific objective of this research was to estimate black-tailed jackrabbit densities in lower elevation pastures. Estimates were made by walking strip census transects 3 mi in length in the major low elevation range sites. (Because of the length of these lines, they often crossed several range site boundaries). Transects were conducted during mid-day when lagomorphs are most sedentary. Perpendicular flushing distance (from the line) was recorded for each rabbit flushed. Densitites were determined for each transect by this formula:

$$\text{Density} = n/2l\bar{r}$$

where n = number of rabbits flushed, l = length of transect, and $\bar{r}$ = mean flushing distance.

Coyotes:

The coyote was chosen as a key species to represent the top of the food chain. Our purpose in studying coyotes on the ranch was to monitor yearly population fluctuations (trend).

To continue our index of coyote populations, we conducted howl count surveys (driven route) consisting of seven stops, 3 mi apart. This route is along major dirt roads which cross the study area. At each stop, a mouth-blown "howler" was sounded for 20 seconds, followed by a 2-minute listening period during which

all elicited coyote howls were recorded. Age class and location (habitat and approximate distance from investigator) were recorded for each responding animal. Howling was done at night and only when windspeed was less than 8-10 mi/hr, since higher windspeeds may bias results.

Results and Discussion

Rodents:

Twenty-six trap grids were conducted during 1981. These grids were located in 11 range sites and distributed within 8 of the grazing system pastures. We caught 1530 rodents during this sampling effort of 10,190 trap-nights. No new rodent species were recorded this year, leaving the number identified at 21 for the study area.

Deer mice continued to be the most abundant and eurotypic rodent (Tables 5-1 and 5-2). They were trapped on all grids, and were the most abundant species in all but two range sites (Loamy Slope 10-14 p.z., and a Wet Meadow site). Deer mice made up more than 50% of all rodents trapped on 18 of the grids.

Half of the trapping effort was concentrated on the two higher elevation Forest Service pastures. Only six species were captured here (Table 5-1) as compared to nine on the BLM pastures (Table 5-2). Highest total rodent density (all species) for all pastures was recorded for the South Slope 14-18" p.z. Range Site in the South Forest Service (SFS) pasture which was ungrazed at the time of trapping. Rodent density here was more than double the populations in the two grids of the same range site in the grazed North Forest Service (NFS) pasture (Table 5-1). However, densities in the Loamy Slope 10-14" p.z. and Upland Browse 12-16" p.z. sites differed only slightly between the two pastures.

Obvious differences in densities and species composition among the four SFS Wet Meadow sites were no doubt due primarily to differences in plant species composition. The meadows were chosen because of these differences and results of these transects will be useful in detecting changes within each meadow over time as the grazing system brings about vegetation response.

Highest rodent density (all species combined) for the BLM pastures was recorded in a grazed Loamy Bottom 8-14" p.z. Range Site in May (Table 5-2). This site was also trapped in June and again in July, with total rodent density decreasing over time. This decrease was not uniform among the species, but was influenced primarily by a steady decline in deer mice (from 4.21/ac in May to 2.35/ac in July) and by the complete disappearance of mountain voles in June and July. The latter event was apparently due to the drying up of the ephemeral creek at this site along with its associated vegetation.

The Loamy 8-10" p.z. Range Site was also trapped over time in both the Lower Sheep Creek (LSC) and Upper Sheep Creek (USC) pastures. Densities were similar compared between times and between pastures (Table 5-2).

Table 5-1. Densities and species composition of rodents trapped on Saval Ranch Forest Service pastures during 1981.

Pasture/ Grazing Status	Range Site	1st Day of Trapping	Species: Deer Mouse	Great Basin Pocket Mouse	Least Chipmunk	Mountain Vole	Western Jumping Mouse	Northern Grasshopper Mouse	Total
			D[1] (%)[2]	D (%)	D (%)	D (%)	D (%)	D (%)	D (%)
North Forest Service (NFS)/ Grazed	Loamy Slope 10-14" p.z.[3]	8/5	2.71(46.6)	2.71(46.6)	0.40(6.8)	-	-	-	5.82(100)
	Upland Browse 12-16" p.z.	8/4	5.34(57.3)	2.39(25.6)	1.58(17.0)	-	-	0.01(0.1)	9.32(100)
	South Slope[4] 14-18" p.z. (a)	8/18	3.52(82.8)	-	0.73(17.2)	-	-	-	4.25(100)
	(b)	8/18	5.34(100)	-	-	-	-	-	5.34(100)
	Aspen Woodland	8/5	9.23(89.1)	-	1.13(10.9)	-	-	-	10.36(100)
South Forest Service (SFS)/ Ungrazed when trapped	Loamy Slope 14-18" p.z.	7/15	4.20(68.9)	-	1.90(31.1)	-	-	-	6.10(100)
	Upland Browse 12-16" p.z.	7/15	7.85(78.5)	-	1.58(15.8)	-	0.57(5.7)	-	10.00(100)
	South Slope 14-18" p.z.	7/19	11.05(80.1)	1.82(13.2)	0.77(5.6)	-	0.16(1.1)	-	13.80(100)
	Wet Meadow (a)	7/20	6.92(57.4)	-	-	3.60(29.9)	1.54(12.8)	-	12.06(100)
	(b)	7/20	2.14(24.5)	-	-	5.06(57.9)	1.54(17.6)	-	8.74(100)
	(c)	7/16	2.83(73.7)	-	-	-	1.01(26.3)	-	3.84(100)
	(d)	7/16	6.48(69.8)	-	1.30(14.0)	-	1.50(16.2)	-	9.28(100)
	Riparian Aspen	7/16	7.53(68.4)	-	3.48(31.6)	-	-	-	11.01(100)

[1]D = Rodent density expressed as number per acre.

[2]% = Species compositon.

[3]p.z. = Precipitation zone.

[4]Letters in parentheses following range site name refer to different trapping grids conducted in same range site and pasture.

Table 5-2. Densities and species composition of rodents trapped on Saval Ranch BLM pastures during 1981.

Pasture/ Grazing Status	Range Site	1st Day of Trapping	Species									
			Deer Mouse	Great Basin Pocket Mouse	Least Chipmunk	Mountain Vole	Western Jumping Mouse	Northern Grasshopper Mouse	Sagebrush Vole	Ord's Kangaroo Rat	Western Harvest Mouse	Total
			D[1] (%)[2]	D (%)	D (%)	D (%)	D (%)	D (%)	D (%)	D (%)	D (%)	D (%)
Upper Sheep Creek (USC)/ Grazed	Loamy 10-12" p.z.[3]	6/19	3.68(62.3)	1.62(27.4)	0.61(10.3)	-	-	-	-	-	-	5.91(100)
	Loamy 8-10" p.z. (1)[4]	7/1	2.95(45.6)	2.39(36.9)	0.69(10.7)	-	-	0.20(3.1)	0.12(1.9)	0.12(1.9)	-	6.47(100)
	(2)	8/11	2.95(48.0)	1.90(30.9)	1.09(17.8)	-	-	0.08(1.3)	0.12(2.0)	-	-	6.14(100)
Lower Sheep Creek (LSC)/ Grazed	Loamy 8-10" p.z. (1)	6/23	2.91(52.9)	1.82(33.1)	0.45(8.2)	-	-	0.08(1.5)	0.12(2.2)	0.12(2.2)	-	5.50(100)
	(2)	8/24	2.27(40.6)	1.54(27.5)	1.38(24.7)	-	-	0.08(1.4)	-	0.32(5.7)	-	5.59(100)
	Loamy Bottom 8-14" p.z. (1)	5/7	4.21(42.0)	1.30(12.9)	0.28(2.8)	2.87(28.4)	-	0.08(0.8)	-	0.12(1.2)	1.25(12.4)	10.11(100)
	(2)	6/30	3.72(47.7)	2.79(35.8)	0.81(10.4)	-	-	0.08(1.0)	0.40(5.1)	-	-	7.80(100)
	(3)	7/28	2.35(41.2)	1.86(32.6)	1.30(22.8)	-	-	0.08(1.4)	-	0.12(2.1)	-	5.71(100)
Upper Mahala Creek (UMC)/ Ungrazed	Loamy 10-12" p.z.	7/28	3.12(42.7)	3.24(43.3)	0.77(10.3)	-	-	-	0.36(4.8)	-	-	7.49(100)
	Claypan 10-12" p.z.	7/28	3.89(51.6)	2.55(33.8)	1.09(14.5)	-	-	0.01(0.1)	-	-	-	7.54(100)
Middle Mahala Creek (MMC)/ Grazed	Wet Meadow (uncut)	5/19	1.98(52.5)	-	-	-	1.01(26.8)	-	0.16(4.2)	0.45(11.9)	0.17(4.5)	3.77(100)
	Wet Meadow (cut)	5/19	2.55(90.1)	-	-	-	-	-	-	0.28(9.9)	-	2.83(100)
Darling Seeding (DS)/Grazed	Crested wheatgrass	6/5	4.86(83.8)	0.34(5.9)	0.36(6.2)	-	-	-	0.12(2.1)	0.12(2.1)	-	5.80(100)
Native Control (NC)/Ungrazed	Loamy 10-12" p.z.	7/8	5.14(53.0)	2.35(24.2)	1.98(20.4)	-	-	0.01(0.1)	0.22(2.3)	-	-	9.70(100)

[1]D = Rodent density expressed as number per acre.

[2]% = Species compositon.

[3]p.z. = Precipitation zone.

[4]Numbers in parenthese following range site name refer to repeated sampling of the same grid over time.

The Loamy 10-12" p.z. Range Site was trapped in three pastures: the grazed USC pasture, and the ungrazed Upper Mahala Creek (UMC) and Native Control (NC) pastures. Total rodent densities were higher in the ungrazed UMC and NC pastures (7.49/ac and 9.70/ac, respectively) than in the grazed USC pasture (5.91/ac).

Differences in rodent densities between cut and uncut wet meadow sites paralleled those between grazed and ungrazed sites described above. Total rodent density was greater (3.77/ac) in an uncut wet meadow than in a cut meadow (2.83/ac. Perhaps even more noteworthy, we trapped five rodent species in the uncut meadow and only two in the cut meadow. (Table 5-2)

Results from this year's rodent trapping are only tentative, and more replication is needed. As the data base increases over the years, we will gain replition, be able to test "before and after" treatments as well as "inside and out," and attempt to explain variablility via control plots and available weather data. We are especially watching and will continue to watch our "key" rodent species (deer mice, pocket mice, mountain voles, and western harvest mice).

Of particular interest is that about 2430 acres in the LSC pasture were plowed and seeded following this summer's sampling. Based on what we know about increasers and decreasers in the literature and from our own data, we may be able to predict the response of some species. The western harvest mouse is one example.

We trapped western harvest mice on only two grids last summer, and trapped them for the first time in 1980 during our third year of inventory. The highest harvest mouse population we have detected was in the Loamy Bottom 10-14" p.z., which will now be adjacent to the new seeding. This species requires a good grass understory and thus may actually increase in this situation. We will be sampling this area to determine response.

Birds:

We conducted 14 bird transects in six pastures during 1981. Because of the length of these transects, most of them pass through two or more range sites. In this manner, we sampled at least 10 range sites for bird populations. Two of the transects were in the South Forest Service (SFS) pasture and the others were in BLM pastures. We recorded 3 new nongame species on the study area in 1981 (Appendix II), bringing our total list to 130 species, of which 118 are nongame.

Bird abundance (all species combined) was highest in a Wet Meadow Range Site in the SFS pasture (Table 5-3), with 164.3 birds per transect day. Greatest species diversity was recorded on this transect (with 21 species) and a Wet Meadow/Riparian Aspen transect (with 22 species), also located in the SFS pasture. Although these transects were not intended for direct comparison with each other, we believe that a major reason for the disparity in total abundance (164.3 vs. 70.9) was time of sampling. The Wet Meadow Range Site was sampled in late June and the Wet Meadow/Riparian Aspen site was sampled in mid-July well after the peak of breeding season. Yellow warblers and Fox sparrows were the dominant species in the wet meadow site, while green-tailed towhees and house wrens were the most abundant species in the Wet Meadow/Riparian Aspen site.

Table 5-3. Relative abundance and species composition of birds in the South Forest Service (SFS) pasture at the Saval Ranch during summer, 1981.

Range Site(s):	Wet Meadow	Wet Meadow/Aspen
Grazing status:	Ungrazed	Ungrazed
Starting date:	6/30	7/15
Species	$\bar{x}^1$ (%)[2]	$\bar{x}$ (%)
Yellow warbler	27.3(16.6)	4.0(5.6)
McGillivray's warbler	7.3(4.4)	5.0(7.1)
Orange-crowned warbler	2.3(1.4)	0.7(1.0)
Yellow-breasted chat	1.7(1.0)	--
House wren	10.0(6.1)	11.0(15.5)
Rock wren	--	0.3(0.4)
Warbling vireo	7.0(4.3)	8.0(11.3)
Sage thrasher	--	0.3(0.4)
Robin	13.0(7.9)	6.3(8.9)
Veery	0.7(0.4)	--
Red-shafted flicker	11.0(6.7)	3.6(5.1)
Yellow-bellied sapsucker	--	0.7(1.0)
Downy woodpecker	--	0.3(0.4)
Green-tailed towhee	12.0(7.3)	15.7(22.1)
Rufous-sided towhee	0.7(0.4)	--
Fox sparrow	23.0(14.0)	0.3(0.4)
Song sparrow	10.7(6.5)	1.3(1.8)
Brewer's sparrow	1.0(0.6)	1.7(2.4)
White-crowned sparrow	--	1.0(1.4)
Lazuli bunting	12.3(7.5)	1.3(1.8)
Black-headed grosbeak	6.3(3.8)	--
American goldfinch	--	0.7(1.0)
Pine siskin	--	0.7(1.0)
Empidonax flycatcher	5.7(3.5)	5.0(7.1)
Western wood pewee	2.3(1.4)	--
Mourning dove	5.3(3.2)	2.3(3.2)
Northern oriole	3.7(2.3)	--
Mountain chickadee	--	0.7(1.0)
Broadtailed hummingbird	1.0(0.6)	--
Total	164.3(100)	70.9(100)

[1] $\bar{x}$ = Relative abundance expressed as mean number of birds observed per transect-day.

[2] % = Species composition.

Six transects were walked in five BLM pastures (Table 5-4). Since these transects crossed several range sites each, we have listed only the two major range sites sampled by each transect. Results of transects walked in grazed versus ungrazed pastures were varied. In the Loamy 10-12" p.z./Upland Browse 12-16" p.z. Range Site combination, total bird abundance was higher in the grazed USC pasture than in the ungrazed UMC pasture (Table 5-4). Meadowlarks and vesper sparrows, ground nesters which might be affected by grass density, were actually much more abundant in the grazed vegetation than in the ungrazed. Horned larks, also ground nesters, were present though not abundant in the ungrazed site, but absent from the grazed site. Eleven species were recorded in the ungrazed area and only six in the grazed counterpart. A 2-week difference in sampling dates between the two areas may have had some effect, but both areas were sampled during the peak of breeding season.

Results of transects conducted in the Loamy 8-10"/Claypan 10-12" p.z. combination are similarly confusing. Meadowlarks were approximately four times more abundant in the ungrazed (LMC) vegetation than in the grazed (LSC), but vesper sparrows were more abundant in the grazed area (Table 5-4). Horned larks were equally abundant in both areas. Eight species were recorded in the ungrazed site and seven in the grazed site.

BLM pastures which were ungrazed this year will be grazed next year, and vice versa. By re-sampling these pastures annually during the same time frame, we expect to learn more about the effects of grazing on nongame birds, especially the key species mentioned. Comparison of the same pasture with itself over time should result in a more accurate assessment of changes in bird populations resulting from grazing treatment. This approach will however necessitate collection of bird data from control sites in order to sort out changes brought on by weather, etc.

Sampling of one transect over time during one season revealed the characteristic decrease in breeding birds with time progression. In the ungrazed MMC pasture, bird numbers dropped from 103.3 per transect-day to 76.3 per transect-day in the Claypan 10-12" p.z. Range Site combination between early and late June (Table 5-4). This time - related change was even more apparent along driven transects conducted in both the grazed USC Foothill road and ungrazed UMC Foothill Road transects (Table 5-5). Total bird abundance dropped from 108.4 to 59.9 in the UMC pasture between early June and early July, and from 109.3 to 51.6 in the USC pasture during the same time period. Although this time - related drop in bird abundance (or at least detection-rate) was expected, it seemed to occur faster this year than in the previous inventory years. We believe this shortened breeding season may have been primarily due to the relatively dry spring. This resulted in a smaller sample size than we would have preferred and impressed upon us the need for intensive bird population sampling in a short time period.

Although both grazed and ungrazed pastures were sampled by the driven transects, they are not particularly suited for comparison with each other (because of differences in range sites crossed), but with themselves as time and the grazing system progress. Range sites for these transects are not listed in Table 5-5, but the UMC Foothill Road transect, for example, intersected more wet meadow sites than the USC Foothill Road transect, and this no doubt influenced species diversity more than did grazing status.

Table 5-4. Relative abundance and species composition of birds in BLM pastures at the Saval Ranch during summer, 1981.

Pasture:	LSC[1]	USC	LMC	MMC	MMC	UMC
Range Sites:	Loamy 8-10" p.z.[2]/ Claypan 10-12" p.z.	Loamy 10-12" p.z./ Upland Browse 12-16" p.z.	Loamy 8-10" p.z./ Claypan 10-12" p.z.	Claypan 10-12" p.z./ Loamy 10-12" p.z. (1)[5]	Claypan 10-12" p.z./ Loamy 10-12" p.z. (2)	Loamy 10-12" p.z./ Upland Browse 12-16" p.z
Grazinn Status:	Grazed	Grazed	Grazed	Ungrazed	Ungrazed	Ungrazed
Starting Date:	6/17	6/17	5/27	6/2	6/30	6/2

Species	$\bar{x}$[3]	%[4]	$\bar{x}$	%	$\bar{x}$	%	$\bar{x}$	%	$\bar{x}$	%	$\bar{x}$	%
Western meadowlark	4.7	(7.0)	28.7	(23.1)	22.3	(27.3)	23.3	(22.6)	2.3	(3.0)	17.0	(15.5)
Sage thrasher	18.3	(27.2)	20.3	(16.3)	11.3	(13.8)	18.7	(18.1)	19.0	(24.9)	26.3	(24.0)
Brewer's sparrow	27.0	(40.1)	29.3	(23.6)	24.0	(29.3)	30.0	(29.0)	18.7	(24.5)	36.0	(32.8)
Vesper sparrow	9.7	(14.4)	37.3	(30.0)	2.6	(3.2)	10.7	(10.4)	18.7	(24.5)	13.3	(12.1)
Green tailed towhee	0.7	(1.0)	8.3	(6.7)	—		—		—		12.0	(10.9)
Sage sparrow	—		—		11.0	(13.4)	—		1.0	(1.3)	0.3	(0.3)
Empidonax flycatcher	0.7	(1.0)	0.3	(0.2)	4.0	(4.9)	4.3	(4.2)	1.3	(1.7)	0.3	(0.3)
Say's phoebe	—		—		—		—		—		0.3	(0.3)
Loggerhead shrike	—		—		0.3	(0.4)	—		—		0.3	(0.3)
Horned lark	6.3	(9.3)	—		6.3	(7.7)	16.3	(15.8)	15.3	(20.1)	3.3	(3.0)
Brewer's blackbird	—		—		—		—		—		0.7	(0.6)
Total	67.4	(100)	124.2	(100)	81.8	(100)	103.3	(100)	76.3	(100)	109.8	(100)

[1]LSC = Lower Sheep Creek, USC = Upper Sheep Creek, LMC = Lower Mahala Creek, MMC = Middle Mahala Creek, UMC = Upper Mahala Creek.

[2]p.z. = Precipitation zone.

[3]$\bar{x}$ = Relative abundance expressed as mean number of birds observed per transect-day.

[4]% = Species composition.

[5]Numbers in parentheses following range site name refer to repeated sampling of the same transect.

Table 5-5. Relative abundance and species composition of birds along driven transects (on dirt roads) in BLM pastures at the Saval Ranch during summer, 1981.

Pasture:	LSC[1]	USC	UMC (1)[4]	UMC (2)	USC (1)	USC (2)
Road:	Sheep Cr. Rd.	Sheep Cr. Rd.	Foothill Rd.	Foothill Rd.	Foothill Rd.	Foothill Rd.
Grazing Status:	Grazed	Grazed	Ungrazed	Ungrazed	Grazed	Grazed
Starting date:	6/22	6/22	6/9	7/8	6/9	7/8
Species	$\bar{x}$[2] (%)[3]	$\bar{x}$ (%)	$\bar{x}$ (%)	$\bar{x}$ (%)	$\bar{x}$ (%)	$\bar{x}$ (%)
Western Meadowlark	4.0(5.1)	5.7(6.1)	23.7(21.9)	4.0(6.7)	26.0(23.8)	3.3(6.4)
Sage thrasher	15.0(19.2)	20.7(22.3)	21.0(19.4)	20.0(33.4)	14.7(13.4)	18.7(36.2)
Brewer's sparrow	25.7(32.8)	27.3(29.4)	23.7(21.9)	16.0(26.7)	22.3(20.4)	12.3(23.8)
Vesper sparrow	14.0(17.9)	26.7(28.7)	19.3(17.8)	6.7(11.2)	22.0(20.1)	3.0(5.8)
Green-tailed towhee	--	2.3(2.5)	9.3(8.6)	9.7(16.2)	15.3(14.0)	10.0(19.4)
Rufous-sided towhee	--	--	--	--	1.3(1.2)	2.3(4.5)
Sage sparrow	4.3(5.5)	0.3(0.3)	--	--	--	--
Lark sparrow	0.3(0.4)	--	--	--	--	--
Fox sparrow	--	--	--	0.3(0.5)	--	--
Song sparrow	--	--	0.3(0.3)	0.3(0.5)	--	--
White-crowned Sparrow	--	--	--	0.3(0.5)	--	--
Robin	--	0.7(0.8)	3.3(3.0)	0.7(1.2)	2.3(2.1)	--
Empidonax Flycatcher	0.7(0.9)	3.0(3.2)	1.7(1.6)	0.3(0.5)	2.7(2.5)	1.0(1.9)
Yellow warbler	--	--	2.7(2.5)	0.7(1.2)	2.0(1.8)	0.7(1.4)
Mourning dove	--	--	1.7(1.6)	0.3(0.5)	0.7(0.6)	--
Horned lark	14.3(18.3)	6.3(6.8)	--	0.3(0.5)	--	0.3(0.6)
Killdeer	--	--	1.0(0.9)	--	--	--
Warbling vireo	--	--	0.7(0.6)	0.3(0.5)	--	--
Total	78.3(100)	93.0(100)	108.4(100)	59.9(100)	109.3(100)	51.6(100)

[1]LSC = Lower Sheep Creek, USC = Upper Sheep Creek, UMC = Upper Mahala Creek.

[2]$\bar{x}$ = Relative abundance expressed as mean number of birds observed per transect-day.

[3]% = Species composition.

[4]Numbers in parentheses following pasture name refer to repeated sampling of the same transect.

From late May until mid-June we conducted 10 nest search transects. Only four nests were located. We concluded that the time and man-power needed for an adequate sample was prohibitive, and this technique was abandoned.

Jackrabbits:

Sampling of jackrabbits was not considered a high priority item this year. However, in order to get an indication of jackrabbit densities we walked seven transects in two BLM pastures (LSC and USC). These lines were conducted in the Loamy Bottom 8-14" p.z. Range Site and an upland mosaic habitat which included primarily the Loamy 8-10" p.z., Loamy 10-12" p.z., and Claypan 10-12" p.z. Range Sites. Results of these transects indicate that blacktailed jackrabbit densities were comparable with last year's. We calculated densities of 147.6/mi^2 in the Loamy Bottom 8-14" p.z. Range Site and 89.4/mi^2 in the upland mosaic habitat.

Coyotes:

We conducted 5 coyote howl count surveys between July and November (1 in July, 1 in August, 2 in September, and 1 in November). One of the September surveys was only half completed because of gusting high windspeeds. Only five coyotes responded on both the early September and November routes. However, we recorded 31 coyotes in July and 35 in August, the two highest counts in four years of howling surveys.

Coyote scats were collected along four road segments and will be examined at a later date to determine food habits.

Shrew Inventory

Inventory trapping for shrews was conducted during 1981 to determine their presence or absence on the study area. Because of the difficulty involved in trapping these small mammals, we trapped only in locations which had potential as shrew habitat according to available literature. Pit-fall traps were set along three different streams in the Wet Meadow/Riparian Aspen Range Site combination. These traps consisted of one-gallon tin cans buried in the ground with the mouth of each can just below the ground's surface. Ten to 16 cans were placed at each location and left for approximately two months.

Nineteen shrews, representing three species (vagrant shrew, northern water shrew, and Merriam shrew) were trapped in 2,500 trap-nights. These species are all that should be present on the study area according to mammal field guides. The following is a summary of trapping results:

Location	Dates	Vegetation	Trap-nights	No. caught by species
Gance Creek	5/24-7/28	dense meadow grass, boggy ground, dense willows.	1040	3 Vagrant shrews 2 Northern water shews

Location	Dates	Vegetation	Trap-nights	No. caught by species
Warm Creek	5/24-7/28	meadow grass, some boggy ground, willows, aspens.	910	9 Vagrant shrews
Mahala Creek	6/3-7/28	invaded meadow with big sagebrush, dry ground, fallen aspens, much bare ground and dead wood.	550	5 Merriam shrews

CHAPTER 6.

FISHERIES RESEARCH

William S. Platts and Rodger L. Nelson

1981 Objective:

Measure the geomorphic and aquatic-riparian, hydrologic, and biologic characteristics of Gance Creek under grazed and protected treatments.

1981 Accomplishments:

This study was initiated on Gance Creek in August, 1978. The data obtained during this preliminary sampling provide a comprehensive description of the aquatic and riparian ecosystems prior to experimental manipulation. Comparison of these baseline data with data obtained in subsequent years will allow a time-trend analysis of the response of the aquatic and riparian ecosystems to the exclusion of cattle grazing relative to the adjacent grazed sites.

The basic design of the study area is to stratify 1800 feet of stream reach into 181 transects placed at 10-foot intervals. This stream reach is then subdivided into three 600-foot sections, the middle section fenced to exclude cattle, while the two outer sections are open to cattle use (Figure 6-1). Annual monitoring of each section then provides information on each relative to the others over the course of several seasons of use.

The data collected fall into four basic categories: 1) geomorphic/aquatic, 2) riparian or streamside, 3) hydrologic, and 4) biologic.

Geomorphic/Aquatic. These measurements describe the physical structure of the stream and can therefore be used to document cattle-induced structural changes when monitored over several grazing seasons.

Water Column. Stream width is a horizontal measurement of that area of the transect covered by water. Pools are classified as that area of the water column usually deeper than riffles and slower in water velocity. Riffle is the remainder of the column. Pool quality rating is based on the pool's ability to provide certain rearing requirements of fish, such as width, depth, and cover, and is ranked from 1 (poor quality) to 5 (high quality). Canopy cover measures incident sunlight, in degrees of arc, not intercepted by nearby objects.

Streambanks. The streambank angle is measured with a clinometer which determines the downward slope of the streambank to the water. Streambank undercut is a direct horizontal measurement, parallel to the stream channel, of the erosion of the bank at the water influence area. Fisheries environment quality ratings depict the general ability of the bank-stream contact zone to provide the conditions believed necessary for high fish standing crops. This rating is a function of both stream characteristics at the bank (pool or riffle) and available cover and is ranked from 1 (poor) to 5 (excellent).

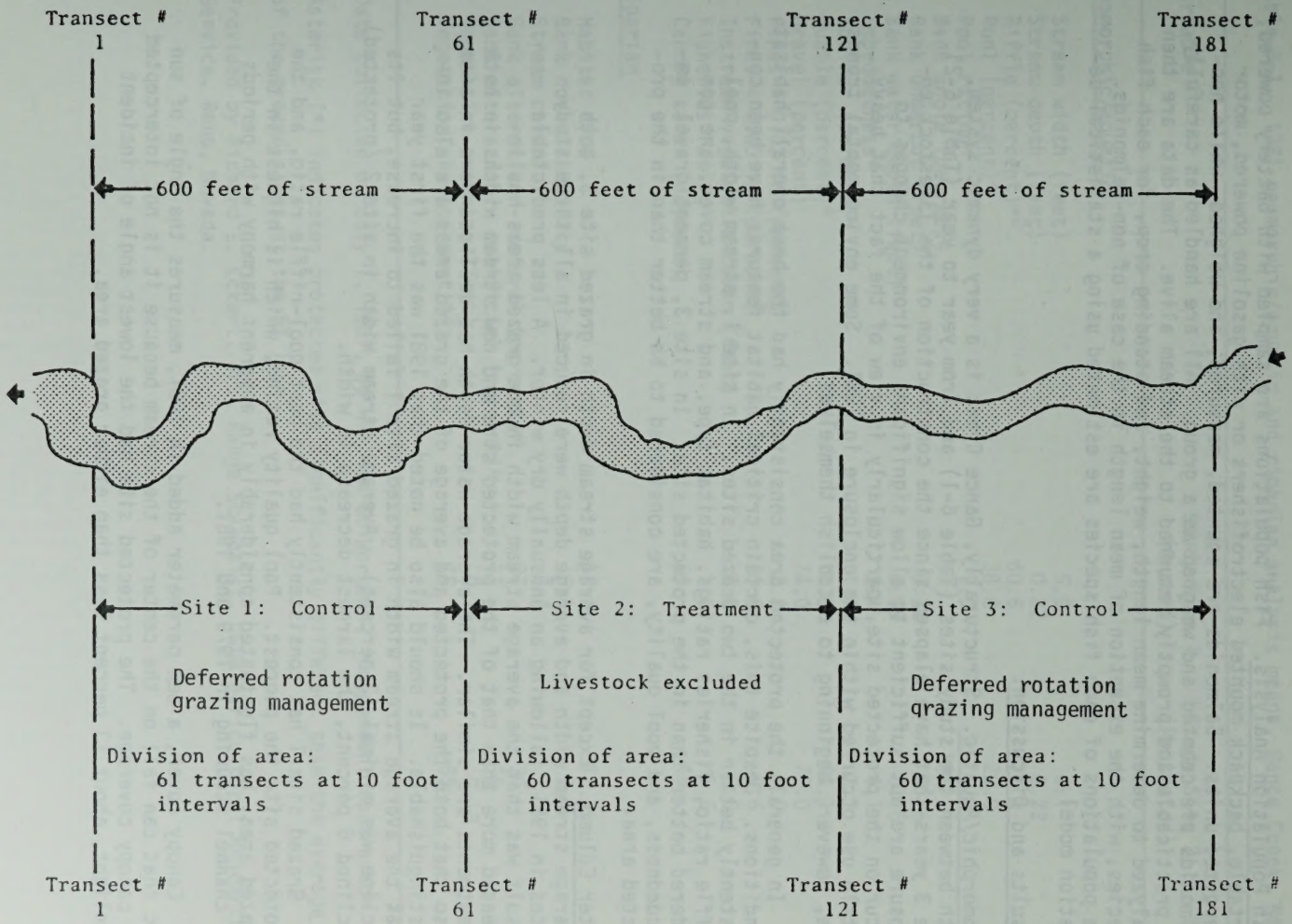

Figure 6-1. Basic design of the Livestock-Fisheries Interaction Studies.

Fish Population Analysis. Fish populations are sampled with battery powered, portable, backpack mounted electrofishers or with gasoline powered, motor energized units. Salmonids are counted, measured, and weighed, while non-salmonids are counted and weighed as a group. All are handled as carefully, as practicable and promptly returned to the stream alive. The data are then analyzed to determine mean length, weight, and standing crop, for each fish species, with the exception of mean length in the case of non-salmonids. The populations of each fish species are estimated using a statistical depletion model.

Results and Discussion:

Geomorphic/Aquatic. Structurally, Gance Creek is a very dynamic system, both between the study sites (Table 6-1) and from year to year (Table 6-2). The 3 years that have elapsed since the construction of the livestock enclosure are not sufficient to allow significant environment changes to occur on the protected site, particularly in view of the fact that heavy cattle use occurred within the enclosure in 1981. Some environmental trends are, however, beginning to establish themselves.

In general, the protected area consistently had the best overall habitat conditions. Despite this, certain critical habitat features have been consistently better in the two grazed sites. In site 1, stream width, pool-riffle ratio, fisheries ratings, habitat type, and stream cover, are considered better than in the protected site. In site 3, percent gravel, embeddedness, and pool quality, are considered to be better than in the protected area.

Water Column. Except for average stream depth in grazed site 3, both average stream width and average depth were reduced in all three study sites in 1981, following an unusually dry winter. A less predictable result was that the average stream width in the grazed areas has increased more than that of the protected site and now stream widths in both treatments are similar. The average water depth has declined more in site 2 so that both the protected and average of the grazed areas are also indistinguishable. It should also be noted that 1981 was the first year that the average stream width in grazed site 1 failed to increase, but its decline was minimal (2 percent). Average stream width in site 2 (protected) declined 6 percent, the largest decrease in width.

Grazed site 1 has consistently had the best pool-riffle ratio, and the protected site the poorest. Pool quality rating, which is highest in the grazed area, has fluctuated considerably in apparent harmony with periods of channel scouring in 1979 and 1981.

Canopy cover, a new parameter added in 1981, measures the angle of sun arc that can fall on the center of the stream because it is not intercepted by canopy coverage. The protected site had the lowest angle of incident sunlight, about 13 percent less than either grazed area.

Table 6-1. 1981 geomorphic/aquatic and riparian analysis means, Gance Creek, Nevada[1]

Variable	Study Site 1 (Grazed)	Study Site 2 (Protected)	Study Site 3 (Grazed)
Geomorphic/aquatic			
Stream width (feet)	5.9	6.1	6.2
Stream depth (feet)	0.22	0.22	0.21
Riffle (percent)*[2]	60.6	77.8	74.1
Pool (percent)*	38.8	22.0	25.9
Pool rating*	1.9	1.3	1.5
Bank angle (degrees)	111	127	135
Bank undercut (feet)	0.22	0.16	0.10
Bank water depth (feet)	0.08	0.05	0.05
Embeddedness*	3.4	4.1	3.9
Boulder (percent)*	1.7	7.3	2.1
Rubble (percent)*	10.8	14.1	1.8
Gravel (percent)	74.0	72.0	80.5
Fines > 0.03 in (percent)	2.8	1.0	5.8
Fines < 0.03 in (percent)	10.6	5.6	9.6
Instream vegetative cover (feet)	0.0	0.0	0.0
Fisheries rating	1.6	1.6	1.5
Canopy cover (degrees)	56	48	55
Riparian			
Habitat type	12.4	12.1	10.8
Bank cover stability	2.1	2.1	2.0
Stream cover*	2.4	1.9	1.9
Bank alteration - natural (percent)*	27	30	25
Bank alteration - artificial (percent)*	17	11	15
Vegetative overhang (feet)	0.15	0.13	0.06
Vegetation use (percent)*[3]	75	>55	75

[1]Data collected on July 1, 1981, by William G. Workman, independent contractor.

[2]Asterisk (*) indicates protected site significantly different than the average of the grazed sites at the 5% level.

[3]Provided by Richard E. Eckert, Jr., Range Scientist, USDA-Agricultural Research Service, Reno, Nevada.

Table 6-2. Summary of annual geomorphic/aquatic and riparian means, Gance Creek, Nevada.

Variable	Study Site/Year											
	Site 1				Site 2				Site 3			
	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981
Geomorphic/Aquatic												
Stream width (feet)	5.1	5.2	6.0	5.9	6.0	5.6	6.5	6.1	4.5	5.5	6.4	6.2
Stream depth (feet)	0.19	0.22	0.24	0.22	0.22	0.22	0.25	0.22	0.15	0.19	0.21	0.21
Riffle (percent)	69.4	73.7	43.1	60.6	78.4	78.6	48.3	77.8	70.6	75.3	53.1	74.1
Pool (percent)	30.6	26.3	56.9	38.8	21.6	21.4	51.7	22.0	29.4	24.7	46.9	25.9
Pool rating	1.9	1.6	2.5	1.9	1.9	1.6	2.5	1.3	1.9	1.8	2.6	1.5
Bank angle (degrees)	126	107	114	111	123	95	121	127	141	114	126	135
Bank undercut (feet)	0.56	0.20	0.17	0.22	0.93	0.33	0.18	0.16	0.82	0.14	0.14	0.10
Bank water depth (feet)[1]	0.05	0.10	0.12	0.08	0.04	0.07	0.10	0.05	0.03	0.04	0.10	0.05
Embeddedness	3.1	3.5	2.1	3.4	3.6	4.0	2.7	4.1	3.8	4.2	3.1	3.9
Boulder (percent)	1.3	3.2	2.3	1.7	1.1	7.3	7.7	7.3	1.7	4.3	3.6	2.1
Rubble (percent)	3.6	13.1	9.4	10.8	8.3	22.5	14.3	14.1	3.0	6.3	3.1	1.8
Gravel (percent)	76.5	67.5	70.7	74.0	80.3	63.6	66.6	72.0	86.2	78.3	74.8	80.1
Fines >0.03 in. (percent)	8.1	4.8	1.7	2.8	1.7	2.5	2.2	1.0	7.9	6.5	3.7	5.8
Fines <0.03 in. (percent)	10.5	11.4	15.9	10.6	8.6	4.5	9.3	5.6	1.2	4.7	14.8	9.6
Instream Vegetative Cover (feet)	0.3	0.3	0.2	0.0	0.1	0.3	0.3	0.0	0.3	0.6	0.3	0.0
Fisheries Rating	1.1	1.4	1.8	1.6	1.1	1.6	1.7	1.6	1.5	1.4	1.7	1.5
Riparian												
Habitat type	6.8	12.1	10.4	12.4	6.1	7.9	10.1	12.1	12.0	8.5	10.6	10.8
Bank cover stability	1.3	1.9	2.2	2.1	1.4	1.6	2.3	2.1	2.2	1.6	2.2	2.0
Stream cover	2.7	3.0	1.9	2.4	2.4	2.5	1.9	1.9	2.7	2.5	1.8	1.9
Bank alteration - natural (percent)	29	27	32	28	30	32	36	30	31	29	33	25
Bank alteration - artificial (percent)	21	14	16	17	15	9	0	11	19	12	12	15
Vegetative overhang (feet)	0.09	0.18	0.07	0.15	0.14	0.12	0.14	0.13	0.06	0.08	0.14	0.06
Vegetative use (percent)[2]	68	72	46	75	53	15	> 0	>55	59	48	42	75

[1] Bank water depth has previously been reported incorrectly, with the decimal point one place too far to the right; the computer program has since been corrected.

[2] 1981 data provided by Richard E. Eckert, Jr., Range Scientist, USDA-Agricultural Research Service, Renewable Resources Center, Reno, Nevada.

Streambanks. The greatest changes in bank angle and undercut occurred in 1979, a period of considerable modification of stream-channel morphology. Although average bank angle was lowest initially in the protected area, the average angle increased more rapidly than on the grazed areas after 1979. This has resulted in near equality between average site bank angle on both treatments. Bank angle is, of course, intimately related to bank undercut, so it is not surprising that bank undercut values have behaved oppositely.

The fisheries environment rating is based on the structural streambank conditions, as well as on the condition of the riparian vegetation. Since the character of these influential parameters has fluctuated over the course of the study, the fisheries ratings of each site have also fluctuated. Presently, average fisheries ratings are higher in all three sites than at the beginning of the study, but have declined slightly after a high in 1980.

Streambottom. The behavior of surface substrate particles, like pool quality have fluctuated in response to the variable nature of Gance Creek hydraulics. In 1979 and, to a less extent, in 1981, there were periods of channel scouring, which is illustrated by the behavior of each substrate class except gravel in 1981 for all sites, rubble in 1981 in site 2, and large fines in 1981 in the two grazed areas. Since there can be some confusion distinguishing large and small fines in the field, behavior of total fines may be helpful. Total fines declined in all sites in 1979 and 1981, with the exception of site 1 in 1981. Scouring in 1981 was less than in 1979, so the relative amount of gravel increased in 1981 as the fines were removed. Why rubble declined in grazed site 3 in 1981 is difficult to explain, but deposition of gravel transported from upstream may well be the reason. Substrate embeddedness behaved precisely as would be expected from these hydraulics, decreasing (higher rating) in 1979 and 1981, and increasing (lower rating) during resedimentation in 1980.

Instream vegetative cover was at a high point in 1979 and has declined to zero in all sites since.

Riparian Analysis. As with the geomorphic/aquatic conditions, the riparian environment is slightly better on the whole in the protected area than in the grazed areas. Riparian vegetation appears to have responded more quickly than structural characters to reduced grazing. In sites 1 and 2, most riparian variables have shown improvement since 1978 (Table 6-1), but in site 3, several have deteriorated.

Streambank habitat type and bank cover stability have generally improved in sites 1 and 2, whereas they have declined in site 3. Initially the protected site was rated poorer for these two variables than was the average of the grazed sites, but has since surpassed the combined habitat type rating of the grazed sites. Vegetation overhang, a component of the fisheries environment rating, has remained relatively stable over the course of the study.

Streamside Herbage Analysis. We have completed our third season of electronic biomass analysis of the streamside vegetation along Gance Creek and have found the technique both immediately satisfactory and of great potential value in riparian studies.

Biomass estimates for the 1981 vegetation samples are similar to 1979 values (Table 6-3). However, vegetation use could not be determined from this technique because of trespass grazing in the enclosure and the fact that utilization cages had not yet been placed in the riparian zone. We would like to rectify this situation as soon as practicable as it would greatly enhance the value of the herbage meter in this study.

Hydraulic and Channel Geometry Analysis. Gance Creek represents a hydrologically unstable system, which has required more hydrologic surveys than we initially thought necessary. As a result, we now possess channel profiles for all hydrologic stations for 3 years, and profiles for four transects in the protected area for 4 years. From this extensive data base, it has become obvious that continued change is the normal state of affairs for Gance Creek.

It was the fortuitous surveying, in 1979, of the four transects in site 2 to recover some data we thought we had missed in 1978, that disclosed to us the unstable nature of Gance Creek. Between the 1978 and 1979 surveys, probably during spring runoff, these transects exhibited the effects of intense channel scouring of up to 2.1 feet, followed by partial refilling in 1980. The profiles obtained in 1980 continue to illustrate this pattern of high activity, as evidence by renewed scouring between 1980 and 1981 of up to 5 inches in the highly embedded site 1. Cutthroat trout, on the other hand, are well distributed throughout the study area, with grazed site 3 the principal rearing area and grazed site 1 supporting the larger adults (Table 6-4). The protected site continues to support a more balanced population than the two grazed sites.

Biological. In the 1980 Progress Report we predicted that the trout population of Gance Creek was probably at or near the carrying capacity of the system and that a crash would probably occur. This prediction has been partially indicated because trout numbers did not continue to increase in 1981, rather they declined slightly (Table 6-5). This cessation of rapid growth appears to be due largely to reduced recruitment of young-of-the-year individuals into the population coupled with reduced vigor in the population as a whole. This suggests that population limits have probably been reached and are currently declining relative to the needs of the fish, further suggesting that an abrupt decline in the fish population may occur in 1982. It is interesting to note that the low condition factors of 1978, a low point in population size, are lower than in 1981. It does not seem unlikely that the poorest condition factors would be observed immediately before an abrupt decline in population size.

Table 6-3. Summary of vegetation biomass and percent utilization estimates, Gance Creek, Nevada[1]

Year/Study Site	Management	Variable: Biomass	Variable: Utilization
		(lb/Ac)	(%)
1979			
Site 1	Grazed	470	N.A.[2]
Site 2	Protected	490	0
Site 3	Grazed	N.D.[3]	N.D.[3]
1980			
Site 1	Grazed	1413	N.A.[2]
Site 2	Protected	2761	0
Site 3	Grazed	1541	44
1981			
Site 1	Grazed	470	N.A.[4]
Site 2	Protected	619	55
Site 3	Grazed	544	N.A.[4]

[1]Differences from Table 9, Progress Report 3, are due to rounding errors in the previous report.

[2]Utilization cannot be determined in Site 1 by comparison to Site 2 due to dissimilarity.

[3]No data; Site 3 was not sampled in 1979.

[4]Not applicable; use in exclosure was about 55 percent overall and higher on streambanks. (R. Eckert, 1981, personal communication, USDA, Agricultural Research Service, Reno, Nevada).

Table 6-4. Fish population analysis results for 1981, Gance Creek, Nevada[1].

Species/Study Site	Total catch	Variable		
		Population Estimate	Mean Length	Mean Weight
	(number)	(number)	(inches)	(ounces)
Cutthroat trout				
Site 1 (Grazed)	203	207	3.39	0.40
Site 2 (Protected)	288	299	2.73	0.23
Site 3 (Grazed)	524	533	2.56	0.17
Total	1015	1040	2.77	0.24
Sculpin				
Site 1 (Grazed)	37	38	N.D.[2]	0.20
Site 2 (Protected)	27	27	N.D.	0.17
Site 3 (Grazed)	0	N.D.	N.D.	N.D.
Total	64	80	N.D.	0.19

[1]Data collected on August 17, 1981, by William G. Workman, independent contractor, in co-operation with USDI-Bureau of Land Management, Elko District and Nevada Department of Fish and Game.

[2]No data.

Table 6-5. Comparison of protected site fish population time trends with average of grazed sites, and total study area time trends, Gance Creek, Nevada.

	Study Site/Year											
	Protected Site				Average of Grazed Sites				Total			
Species/Variable	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981
Cutthroat trout												
Total Catch (#)	64	184	294	288	71	196	388	364	206	575	1069	1015
Population Estimate (#)	64	203	303	299	72	208	417	370	207	619	1135	1040
Mean Length (in)	3.57	2.19	2.82	2.73	3.46	2.20	2.38	2.97	3.12	2.18	2.45	2.77
Mean Weight (oz)	0.73	0.31	0.52	0.23	0.60	0.25	0.34	0.29	0.49	0.26	0.37	0.24
Estimated Biomass (oz/ft^2)	0.013	0.019	0.040	0.019	0.015	0.016	0.038	0.029	0.011	0.016	0.037	0.022
Estimated Standing Crop ($\#/ft^2$)	0.018	0.060	0.078	0.082	0.025	0.065	0.112	0.102	0.022	0.060	0.100	0.095
Sculpin												
Total Catch (#)	1	2	5	27	102	9	27	19	204	20	58	64
Mean Weight (oz)[1]	0.49	0.17	N.D.[1]	0.17	0.05	0.23	N.D.	0.20	0.05	0.20	N.D.	0.19
Observed Biomass (oz/ft^2)	0.000	0.000	N.D.	0.001	0.002	0.001	N.D.	0.001	0.001	0.004	N.D.	0.001
Observed Standing Crop ($\#/ft^2$)	0.000	0.011	0.001	0.007	0.035	0.003	0.007	0.005	0.022	0.002	0.005	0.006

[1] No data.

In general, it appears that the cutthroat trout of Gance Creek, which we consider to be Humboldt cutthroat trout (Salmo clarki spp.) rather than Lahontan cutthroat trout (Salmo clarki henshawi), are well adapted to this labile stream system. Good habitat conditions appear to be met with large increases in trout numbers and biomass, though this has the potential disadvantage of setting up an abrupt population decline. In such a situation as this, however, marginal conditions probably occur frequently, making the population fluctuations an effective survival strategy for this subspecies over the long term.

Conclusions:

Three grazing seasons have elapsed since construction of the Gance Creek livestock exclosure in 1978. This is too short a period of time in which to expect to see major improvements in habitat conditions, particularly in view of the apparently unstable nature of the system as a whole. It is also important to realize care must be taken when comparing data early in a time-trend study such as this. The dynamic nature of any stream system results in a certain amount of natural fluctuation in habitat conditions. The effects of such unwanted occurrences as the heavy grazing in the exclosure in 1981 adds additional confounding influences relative to data analysis, as well as impacts that may persist for some time.

The riparian streambank environment within the exclosure appears to be improving in quality, with some improvement also evident in the control sites, though this trend appears to have slowed somewhat in 1981. Unfortunately, we were compelled to collect data before cattle were concentrated in the south pasture (deferred) in 1981, so the true impact of the increased use inside and outside the exclosure in 1981 will not be recorded until next year. As a result, it would definitely be premature to predict with confidence that there will be future improvements in riparian vegetation conditions.

Structural conditions respond more slowly to protection than do vegetative conditions, and we have not yet been able to separate any trends based on direct livestock impacts from the effects of the dramatic hydraulics of the stream system. This is not to imply that natural instability is more influencing to the stream environment than the effects of land uses, because, though climatic conditions are certainly variable, historic land management may have affected the capacity of the watershed as a whole to withstand climatic variability, thereby destabilizing Gance Creek in the study area.

Cutthroat trout populations in the study area appear to be remarkably well adapted to the variable nature of the Gance Creek system. Natural selection for an ability to survive in this Great Basin stream probably enabled the indigenous Humboldt cutthroat trout to withstand the introduction of other trout species and enables them to survive under the current suboptimal conditions. This is obviously fortuitous, but it would be wrong to assume that since the trout are capable of surviving these conditions, maintenance of good habitat is unnecessary. The fact that too little of the population dynamics of the Humboldt cutthroat is presently known and its uniqueness are certainly grounds for preserving the fish and properly managing their habitat.

Based upon the data we have accumulated to date, we believe that the current grazing management (deferred rotation) on the East Independence Allotment is not favorable to riparian and aquatic habitats on Gance Creek. The grazing system will be slightly modified beginning in 1982, by delaying the grazing season and using a stutter-deferred system. This will allow us to evaluate the fishery implications of the modified deferred system relative to the present system.

CHAPTER 7

HYDROLOGY RESEARCH

Steven A. Loomis, William F. Frank, and John C. Brown

1981 Study Objectives:

The specific study objectives for 1981 are described in the various subsections of the report and are aimed at addressing the following general objectives:

1. Evaluate the effects of livestock management and range improvements on the hydrologic response from various range sites, pastures and watersheds.

2. Test and validate procedures for predicting the hydrologic effects of different livestock management options and range improvements on the Saval Ranch and similar rangeland areas.

3. Evaluate the potential for implementing soil and water conservation measures to reduce sedimentation in meadows and irrigation ditches and increase water use efficiency.

Several components of the field study are underway, including climatic data collection, streamflow and water quality monitoring within the main channel system, hydrologic response evaluation from small instrumented watersheds, rainfall simulation, and monitoring of channel morphology. Significant volumes of data are in the process of being reduced, and preliminary data analysis has begun on several aspects of the hydrology study.

1981 Accomplishments:

1. During 1980 and 1981 intensive soil and plant community inventories were completed on approximately 3,575 acres within the Upper Mahala Creek pasture. The inventories are being used to assist in selection of rainfall simulation plots and instrumented watersheds with regard to the vegetation and soil characteristics of the area. The level of detail at which these inventories were completed (minimum 2-acre delineations) precludes the inclusion of the completed photos and narratives. Copies are available from the Bureau of Land Management, Denver Service Center.

2. Precipitation data collection and analysis continued in conjunction with University of Nevada, Reno (UNR) and Agricultural Research Service, Boise (ARS) personnel.

3. Monitoring of four surface water gaging stations on Gance and Mahala Creeks continued and various runoff parameters were analyzed.

4. Main channel streamflow measurements and sediment sampling were conducted by UNR personnel at several sites. Estimates of total streamflow and total sediment yield were calculated.

5. A flood-frequency analysis was performed utilizing U.S. Geological Survey peak flow records.

6. Two small basins on the eastern flank of the Independence Range were selected and instrumented for ongoing monitoring.

7. A modeling effort was initiated within the Saval hydrology program for use in evaluating hydrologic response of various spatial units on the study area.

8. Water quality sampling was continued at a reduced scale. A relationship was derived between sediment yield and peak streamflow for the snowmelt runoff period.

9. A stream channel survey was conducted on Mahala Creek to help document changes in channel morphology as a function of various causative factors.

10. A rainfall simulation study was conducted on two range sites within the Upper Mahala Creek pasture. Data was analyzed and relationships were derived between various cover characteristics and hydrologic responses.

Methodologies, Results, and Discussions:

The various facets of the hydrology study are presently being carried out within the Gance, Mahala, Sheep, and Stump Creek drainages. Figure 7-1 shows the locations of the four U.S. Geological Survey surface water gaging stations, the two instrumented small watersheds, the rainfall simulation study locations, soil and vegetation inventory sites, and the Mahala Creek channel survey reach. Figure 1-1 in the climate chapter shows the locations of the eleven climatic stations and their associated instrumentation.

Methodologies, results and discussions for each of the components of the hydrology study are presented in the following sections.

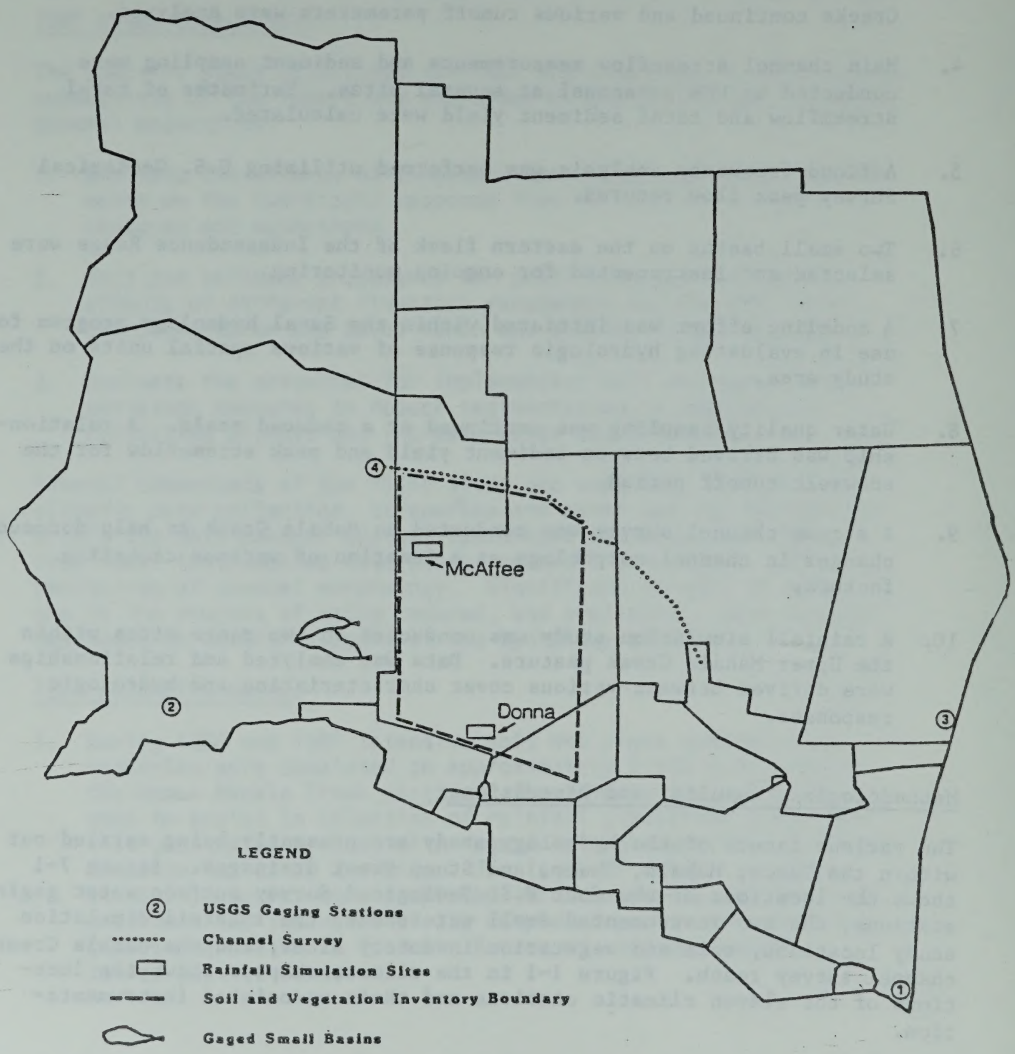

Figure 7-1. Saval Ranch hydrology study locations.

PRECIPITATION

The majority of the climatic data and discussion is reported in Chapter 1. Personnel at the ARS Northwest Watershed Research Center (NWWRC) in Boise are in the process of reducing the records for each of the precipitation stations on the study site. Some of the data reduction is completed and will be presented in the 1981 NWWRC Interim Report to the Denver Service Center, BLM.

As sufficient climate, runoff, and other resource data become available, various hydrologic and forage models will be evaluated within the context of the Saval hydrology program. Precipitation characteristics, including the distributions of storm durations, amounts, and intensities, may be required for the forecasting mode within the modeling effort. The 2 to 3 years of existing Saval climate data will allow an initial inspection of the precipitation characteristics for comparison to long-term records at Elko and NWWRC. In order to extend the Saval data record, correlations between the study area and these surrounding stations will be necessary. Annual and monthly precipitation generators have already been developed by NWWRC for locations in Idaho and surrounding states, and these methods can be applied to the Saval study area for future modeling efforts.

As part of the precipitation data analysis for the study area depth-duration-frequency curves were developed using the data and methods described in the Precipitation-Frequency Atlas for Nevada (Miller et al., 1973). These curves are typically used in conjunction with various runoff estimation methods for evaluation of land management treatments and design of water retention structures. Figures 7-2 and 7-3 can be used to estimate the probability of a particular amount of rainfall occurring over a given storm duration. For example, 0.7 inches of rain will fall at the Saval Ranch within a 30-minute period, on the average, once every 10 years.

The methodology for developing the curves requires some interpolation of intermediate values between lines of equal precipitation shown on the published maps. The interpolations used and subsequent equations involving elevation result in the curves in Figure 7-2 being applicable to the higher elevations of the study area. Actually the relationships can probably be extrapolated to the lower elevations of the ranch with little loss in accuracy. For comparison the same analysis was made for Elko, and the resulting curves are shown in Figure 7-3. The Elko relationships are likely more accurate than those for the study area, as the original Elko data was drawn from a 20-year record. The data utilized for the Saval study area results from interpolations between several surrounding, yet distant (45 miles) weather stations. The data and equations utilized have tabulated values associated with them which should be inspected when the figures are used.

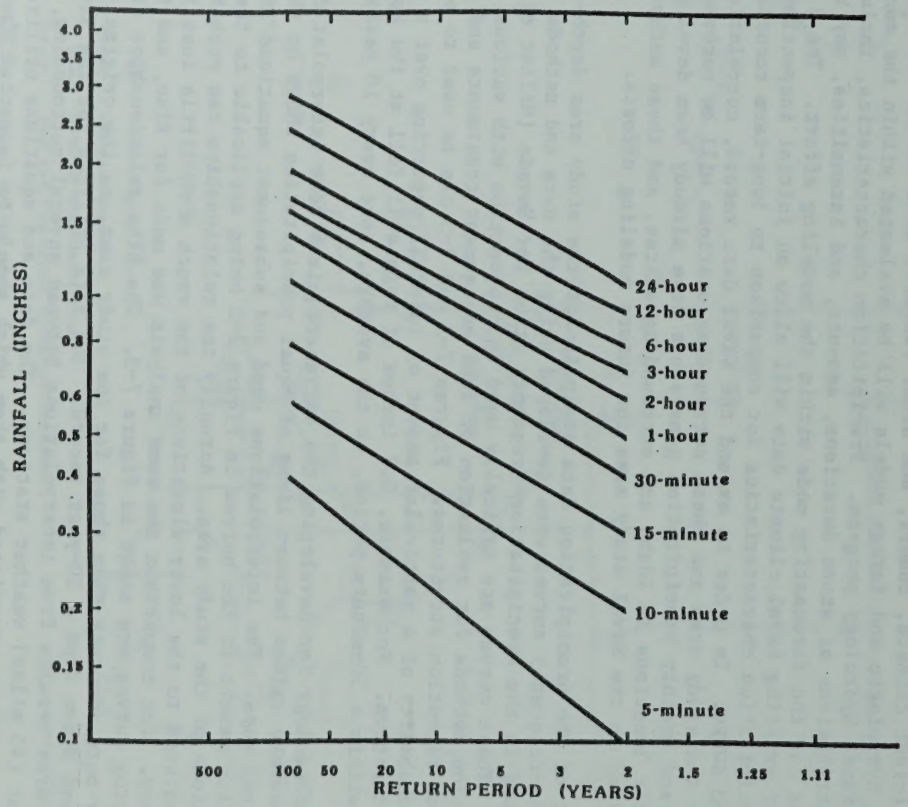

Fig. 7-2. Depth-duration-frequency for the Saval study area.

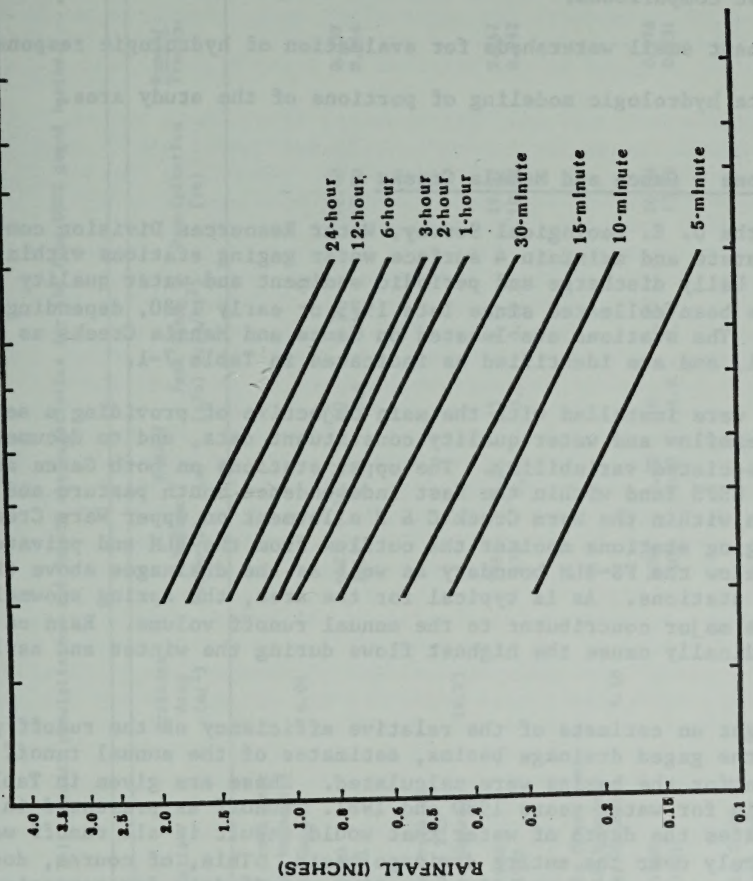

Fig. 7-3. Depth-duration-frequency for Elko, Nevada.

RUNOFF

The runoff measurement and analysis portion of the hydrology program is directed at several objectives, and includes a number of cooperators. The objectives include:

1. Continue to develop a set of main channel baseline streamflow and water quality data for model testing as well as comparative purposes.

2. Apply flood frequency analyses to available streamflow data for model forecast comparisons.

3. Instrument small watersheds for evaluation of hydrologic response.

4. Initiate hydrologic modeling of portions of the study area.

Gaging Stations - Gance and Mahala Creeks

During 1981 the U. S. Geological Survey, Water Resources Division continued to operate and maintain 4 surface water gaging stations within the study area. Daily discharge and periodic sediment and water quality information has been collected since late 1979 or early 1980, depending on the station. The stations are located on Gance and Mahala Creeks as shown in Figure 7-1, and are identified as indicated in Table 7-1.

The stations were installed with the main objective of providing a set of baseline streamflow and water quality constituent data, and to document the amount of associated variability. The upper stations on both Gance and Mahala drain USFS land within the East Independence South pasture and a small portion within the Warm Creek C & H allotment on upper Warm Creek. The lower gaging stations monitor the outflow from the BLM and privately-owned land below the FS-BLM boundary as well as the drainages above the upper gaging stations. As is typical for the area, the spring snowmelt period is the major contributor to the annual runoff volume. Rain on snow events periodically cause the highest flows during the winter and early spring.

In order to get an estimate of the relative efficiency of the runoff production for the gaged drainage basins, estimates of the annual runoff and precipitation for the basins were calculated. These are given in Table 7-1 for each basin for water years 1980 and 1981. Runoff as presented in inches indicates the depth of water that would result if all runoff was spread uniformly over the entire drainage basin. This, of course, does not occur, but is a convenient way of presenting runoff data for comparisons between areas.

The annual precipitation for each basin of interest was calculated using the Thiessen polygon method as discussed in Linsley et al. (1975). The method utilizes the precipitation values for neighboring stations and weights them based on the area of geometric zones of influence around each station. One of the limitations of the Thiessen method is that

Table 7-1. Annual precipitation and runoff characteristics for the four USGS gaged basins.

Location	Drainage Area (mi^2)	Runoff Volume (acre-ft)	Runoff Volume (in)	Peak Flow (cfs)	Peak Flow (cfs/mi^2)	Precipitation (in)	Runoff / Precip.	Date of Peak Flow
Gance Creek near FS-BLM boundary (Upper Gance)	6.04							
1980		4523	14.04	60	9.93	26.40	0.532	4-22
1981		1865	5.79	8.8	1.46	15.90	0.364	5-1
Gance Creek at Highway 225 (Lower Gance)	19.23							
1980		2984	2.91	53	2.76	19.81	0.147	4-24
1981		472	0.46	3.6	0.19	10.88	0.042	2-15
Mahala Creek near FS-BLM boundary (Upper Mahala)	4.18							
1980		1048	4.70	16	3.83	26.34	0.178	4-20
1981		109	0.49	1.8	0.43	15.78	0.031	4-26
Mahala Creek at Highway 225 (Lower Mahala)	22.57							
1980		1974	1.64	28	1.24	18.02	0.091	4-22
1981		36	0.03	1.7	0.08	9.76	0.003	3-27

orographic influences are ignored in the weighting of the precipitation between stations. That is, precipitation is assumed to vary linearly between stations, and is not considered to be a function of the topography. These limitations are probably not critical for the Saval climatic network, since the density of stations is fairly high, and they represent the major topographic expressions.

The ratio of annual runoff to annual precipitation in Table 7-1 is an indication of the runoff-producing efficiency of the watersheds. The Upper Gance and Mahala gaging stations should record relatively unconfounded runoff amounts since there are no irrigation diversions or return flows. The Lower Gance and Mahala stations on the other hand are measuring the flows from the respective drainages after some percentage has been diverted for irrigation use. Some of this diverted water returns to the main channels to be gaged at the stations at State Highway 225.

The runoff efficiencies for all basins except Upper Gance appear to fall within a reasonable range (less than 1 to 18 percent of annual precip.). These values are similar to those reported for sage-grass vegetation types in other studies (Branson, et al., 1981; ARS, 1981). The runoff efficiencies for both 1980 and 1981 (53 and 36 percent, respectively) for the Upper Gance Creek basin appear to be extremely high. A plot of hypsometric curves for both the Upper Mahala and Upper Gance basins indicate that the latter basin is, on the average, approximately 200 feet higher in elevation. Within the Gance Creek basin, both Warm Creek and Gance Creek are perennial streams. Within the Mahala Creek basin the flow is not perennial immediately at the gaging station, partially as a result of significant transmission losses through the channel bed. The result is that the live channel drainage density may be somewhat higher within the Gance Creek basin as compared to the Mahala Creek basin. This reflects more efficient delivery of snowmelt runoff and baseflow to the gaging station on Upper Gance Creek. Even with these factors affecting the apparent runoff efficiency as measured at the gaging station, the values still appear to be very high.

The flow measured at each gaging station is obviously surface water only, and thus does not include any component of flow occurring through the channel alluvium. From visual observations at some points in the channel system it is apparent that this underflow component may be a significant proportion of the total flow at certain periods during the year. The main channel of Mahala Creek has several locations where this subsurface flow is evident, especially during periods of low surface flow.

Main Channel Flow and Sediment Sampling

In order to improve the spatial detail of the stream discharge and sediment load characteristics for the study area, the University of Nevada, Reno (UNR) continued their stream monitoring program at several sites within the main channel system. Some of the sampling locations can be used for verification within the context of the ongoing and future modeling efforts. The monitoring program was scaled down considerably from previous years, and some redirection took place. Sampling sites were added above and below the diversion and channel work on Mahala Creek, in order to document potential effects of future channel stabilization structures on the sediment load

within the reach. Sixteen sites were sampled for suspended sediments and streamflow during the snowmelt runoff period. Of these, 10 sites were monitored frequently enough to develop estimates (Table 7-2) of total streamflow (acre-feet) and total sediment yield (tons) for the period. As a result of the intermittent sampling routine by UNR, the peak flow values in Table 7-2 may not be the same as for the corresponding stations in Table 7-1.

Data from Tables 7-1 and 7-2 reflect the fact that 1981 was a much lower precipitation and runoff year than 1980. While the 1981 precipitation for individual climatic stations ranged from 40 to 67 percent of 1980 values, runoff volumes at the UNR stream sampling sites (Table 7-2) averaged much less for the same year-to-year comparison.

Flood Frequency Analysis

A crest-stage gage has been in place at the lower Mahala Creek gaged site at the highway since 1966. However, a flow of 541 cfs was estimated for a rain-on-snow event on February 10, 1962. The lowest annual peak flow on record since the site has been gaged occurred this last year on March 27, 1981, and was recorded as 1.7 cfs. The annual peak flows as summarized from the USGS records for Discharge at Partial-Record Stations and Miscellaneous Sites are listed in Table 7-3.

In order to estimate the frequency of occurrence of an annual peak flow event, the data in Table 7-3 were plotted on probability paper. The Log Pearson Type III frequency distribution is generally considered the standard method for flood frequency analysis, and thus was utilized here. The coefficient of skewness of the observed data is one of the values needed for estimating the flood frequency curve. For stations with a short period of record (less than 25 years) it is recommended that generalized skew coefficients be utilized (U. S. Water Resources Council, 1977). The generalized values are estimates based on a number of station records within a geographic region. The flood frequency curves developed using both a generalized skew coefficient and the coefficient from the observed data are presented in Figure 7-4.

Both curves estimate essentially the same annual peak flows for the low to intermediate return periods, but the curve utilizing the generalized skew coefficient indicates much larger flows at the longer return periods. The large flow of 1962 (541 cfs) has a significant effect on the resulting flood frequency curves. If this flow event is not utilized the curve developed from the actual data skew would indicate a much smaller annual peak flow at the longer return periods. With the short period of record (17 years) the upper end of each curve must be utilized with caution.

Moore (1976) derived an empirical relationship to estimate the 10-year return period peak discharge as a function of 1000-foot elevation zones for basins in Nevada of less than 150 square miles in area. His method consists of applying a tabulated unit discharge (cfs/mi^2) to each elevation zone within the basin in question, then summing the discharges estimated for all zones to produce a total discharge for the basin. The estimated 10-year peak discharges for the basins above each of the four USGS gaging stations are shown in Table 7-4.

Table 7-2. Streamflow and Sediment Yield for the 1981 Snowmelt Runoff Period

Sampling Site	Site No.[1]	Streamflow Volume (acre-ft)	Streamflow Volume (% of 1980)[2]	Streamflow Peak (cfs)	Sediment Yield (tons)	Sediment Yield (% of 1980)[2]
Gance at Highway 225	3	135	4.7	1.7	2.32	2.8
Gance nr. FS-BLM bndry.	9	755	22.0	8.7	17.10	2.7
Jim at Foothill Road	21	112	10.9	1.4	2.00	1.9
Mahala at Highway 225	18	2	0.1	0.1	0.03	0.1
Mahala at 4-Corners	22	35	3.0	0.9	1.02	0.1
Mahala at Foothill Road	23	197	18.0	2.1	16.31	3.9
Mahala nr. FS-BLM bndry.	24	120	11.2	2.0	1.63	0.6
Mahala below SCS work	32	237	----	2.1	9.08	---
Mahala above SCS work	33	258	----	2.3	6.56	---
Sheep near reservoir	28	7	5.8	0.1	1.09	2.6

[1]Site numbers are consistent with those in 1980 UNR Hydrology Annual Report

[2]Streamflow and sediment yield values as a percentage of the corresponding 1980 snowmelt period values.

Table 7-3. Annual Peak Flow Values at the Mahala Creek at Highway 225 Gaging Station (1962, 1966-1981).

Date	Flow (cfs)
2-10-62	541
3- -66	15
5- -67	40
2-21-68	4
4- -69	70
6- -70	78
-71	100
6-1-72	70
3-10-73	29
2-28-74	64
5-4-75	66
9- -76	25
5- -77	5
3- -78	47
-79	38
4-22-80	28
3-27-81	1.7

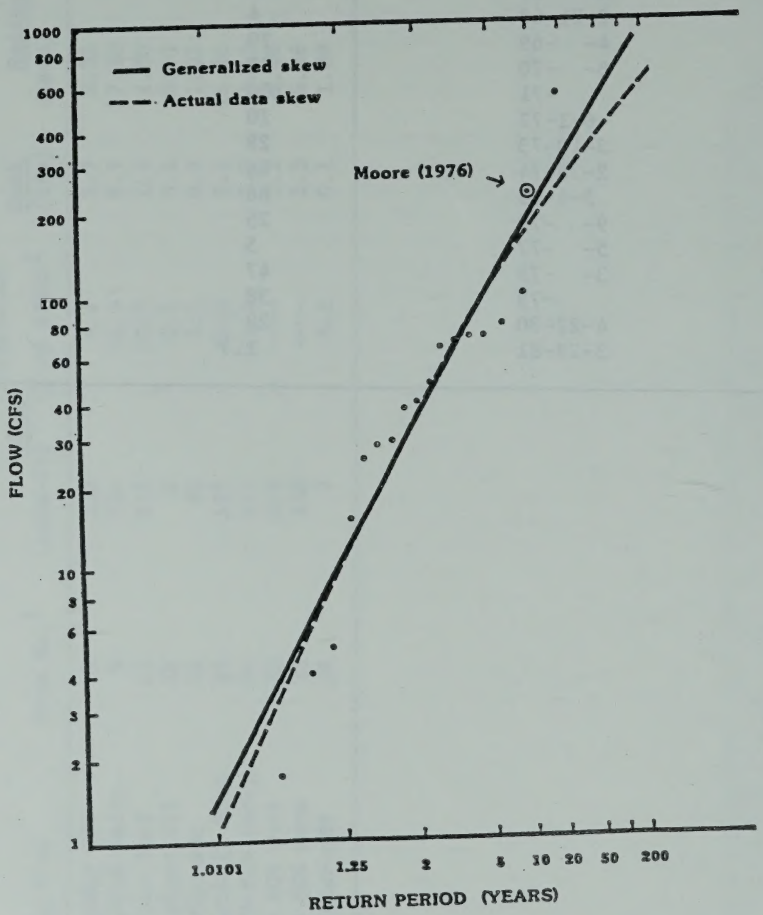

Fig. 7-4. Flood-frequency curve for Mahala Creek at State Highway 225.

Table 7-4. 10-Year Peak Discharges Using the Method of Moore (1976)

Station	Flow (cfs)
Upper Gance	72
Lower Gance	205
Upper Mahala	48
Lower Mahala	234

The value for Mahala Creek at the highway is plotted on Figure 7-4 in order to show its relationship to the theoretical flood frequency curve. The 1980 and 1981 observed peak flows for the 4 basins (Table 7-1) do not show as large a discrepancy in flow rates between the upper and lower stations as the 10-year estimates using Moore's method would indicate.

The flow and sediment yield data being collected at the gaging stations and other points within the stream system should begin to provide a set of basin response characteristics which can be utilized within the context of the modeling efforts. The flood frequency relations can be compared to possible long-term forecasts for testing and validation of the hydrologic component of forage production and other system models.

The hydrologic response characteristics measured within the main channel system are a function of numerous processes occurring on the surrounding uplands as well as within the channels themselves. Many response units which might be considered relatively homogeneous with respect to their soil, vegetation, and hydrologic characteristics contribute to the response measured at a point within the channel. In order to adequately estimate the response at a point and evaluate the effects of land management on that response, the effects of the component contributing areas must be understood.

Small Watershed Installations

Two small basins (55 and 60 acres) on the eastern flank of the Independence Range were selected and each was instrumented with an H-flume, approach box and a strip chart water level recorder. Through the fall of 1981 no flow was measured from the two basins, as they are predominantly snowmelt driven. Automatic suspended sediment samplers will be installed at each basin during the spring of 1982. Appropriate resource characterzation, including soil and vegetation inventories, along with climatic inputs, will allow testing of various hydrologic response models. The sensitivity of the basin response to changes in vegetation characteristics will be a key issue in the subsequent evaluations of livestock management effects. Any future modeling efforts will also need to reflect this same level of sensitivity (or lack of it), if it is to adequately predict the effects of land management. Subsequent instrumented basins will broaden the scope of range sites and livestock management treatments which can be evaluated.

Modeling

A modeling effort has been initiated within the context of the Saval hydrology program for use in evaluating the hydrologic response characteristics of various spatial units from range sites to pastures and large basins. Models to be tested and validated range from simple rainfall-runoff relationships to forage production models which contain a hydrologic component. Several of these models have been modified to incorporate the effects of livestock management, but few of them have been adequately tested.

During 1981 the modeling objectives were mainly directed at:

1. Continuing the overall climatic, runoff, and water quality data collection efforts for subsequent testing and validation of the various models of interest.

2. Familiarization with possible models to be applied within the hydrology program, including ties to forage production modeling.

The modeling effort was barely initiated at the end of 1981 with emphasis being placed on the Agricultural Research Service - Ekalaka Rangeland Hydrology and Yield Model (ERHYM) (ARS, 1982). It is essentially a forage production model with a hydrology routine that presently operates on a range site basis. Most of the effort for 1981 was limited to planning for 1982 model operation and testing.

The hydrology component of the model is essentially a slightly modified version of the Soil Conservation Service Runoff Curve Number Method (1972). It is one of the most widely used methods for runoff prediction from rainstorms, and consequently, numerous papers have dealt with the application, modification, and limitations of the method.

The basic equation utilized in the method is:

$$Q = \frac{(P-I_a)^2}{(P-I_a+S)} \qquad \text{for } P \geq I_a \qquad (7\text{-}1)$$

where P is the storm rainfall in inches; I_a is the initial abstraction which includes interception, infiltration, and surface storage occurring before runoff begins; S is a watershed storage factor equal to the maximum possible difference between effective precipitation ($P-I_a$) and runoff (Q); and Q is the direct storm runoff in inches.

A relationship was derived for an average watershed condition, which related the initial abstraction to the storage factor, in the form of

$$I_a = 0.2S \qquad (7\text{-}2)$$

Combining equations (7-1) and (7-2) results in the widely used relationship

$$Q = \frac{(P-0.2S)^2}{(P+0.8S)} \qquad \text{for } P \geq 0.2S \qquad (7\text{-}3)$$

The storage factor (S) can theoretically range from zero to infinity, so for ease of use it is transformed to a parameter called the curve number (CN) by the relationship

$$CN = \frac{1000}{10+S} \qquad (7\text{-}4)$$

Thus the CN can vary from 0 when S is infinity (a completely pervious watershed with absolutely no potential for runoff), to 100 when S is zero (a completely impervious watershed on which runoff will equal rainfall). With a given storm rainfall and an estimate of the CN for the watershed of interest, the direct storm runoff can be predicted. This simplified model contains many assumptions as to the behavior and interactions of the storm and watershed in question.

The CN for a watershed can be determined in basically one of two ways. Tables, graphs, and figures are available which assist in estimating a CN on the basis of soil type, vegetative type, total fraction of ground covered by vegetation and litter, and antecedent moisture conditions (SCS, 1972; Branson et al, 1981). Curve numbers can also be determined directly from watershed response data by using a rearrangement of equation (7-4):

$$S = 5(P+2Q-\sqrt{4Q^2+5PQ}) \qquad (7\text{-}5)$$

and known precipitation and runoff values.

In order to estimate the runoff potential of a particular watershed in question, CN's for the various range sites within the watershed must be selected. As an example of the methodology the runoff curve number method was applied to the Upper Gance and Upper Mahala basins. By utilizing an overlay of the drainage basin boundaries and the map of soil associations in Figure 8 of the Saval Coordinated Management Plan (BLM, 1981) the total area of each soil association within each of the two basins was determined. This same figure also contains a breakdown for each soil association of the percentages of each range site contained therein. Thus, the approximate area of each range site contained within each basin can be determined.

Contained within the range site descriptions which apply to the Saval study area is an estimated CN for each range site (SCS, 1980). A set of CN's, one representing every range site on each basin is then prepared. Equation (7-5) can be used to convert the CN to a value of S, the storage factor, for each range site. By selecting a storm precipitation and applying equation (7-4) to each range site, an estimated direct storm runoff can be calculated. By weighting the calculated runoff values for each range site by the fractional area of each range site within the watershed, and summing the weighted runoff values, the estimated storm runoff for the entire watershed can be determined.

By using this method with several different assumed storm precipitation values, and calculating the corresponding watershed runoff, a plot of precipitation versus runoff can be made (Figure 7-5). Interestingly enough, the resulting curves for the Upper Gance and Upper Mahala Creek basins are almost identical.

This method has been utilized for evaluation of livestock grazing effects by the addition of a routine which relates grazing intensity to infiltration, and subsequently to runoff curve numbers (Gifford and Hawkins, 1978). Another adaptation is that of Fogel et al. (1978), which includes a sediment yield function (Williams and Berndt, 1972) and a routine to generate a simulated precipitation time series. Within the context of the Saval hydrology program, these methodologies can be tested and modified if deemed necessary.

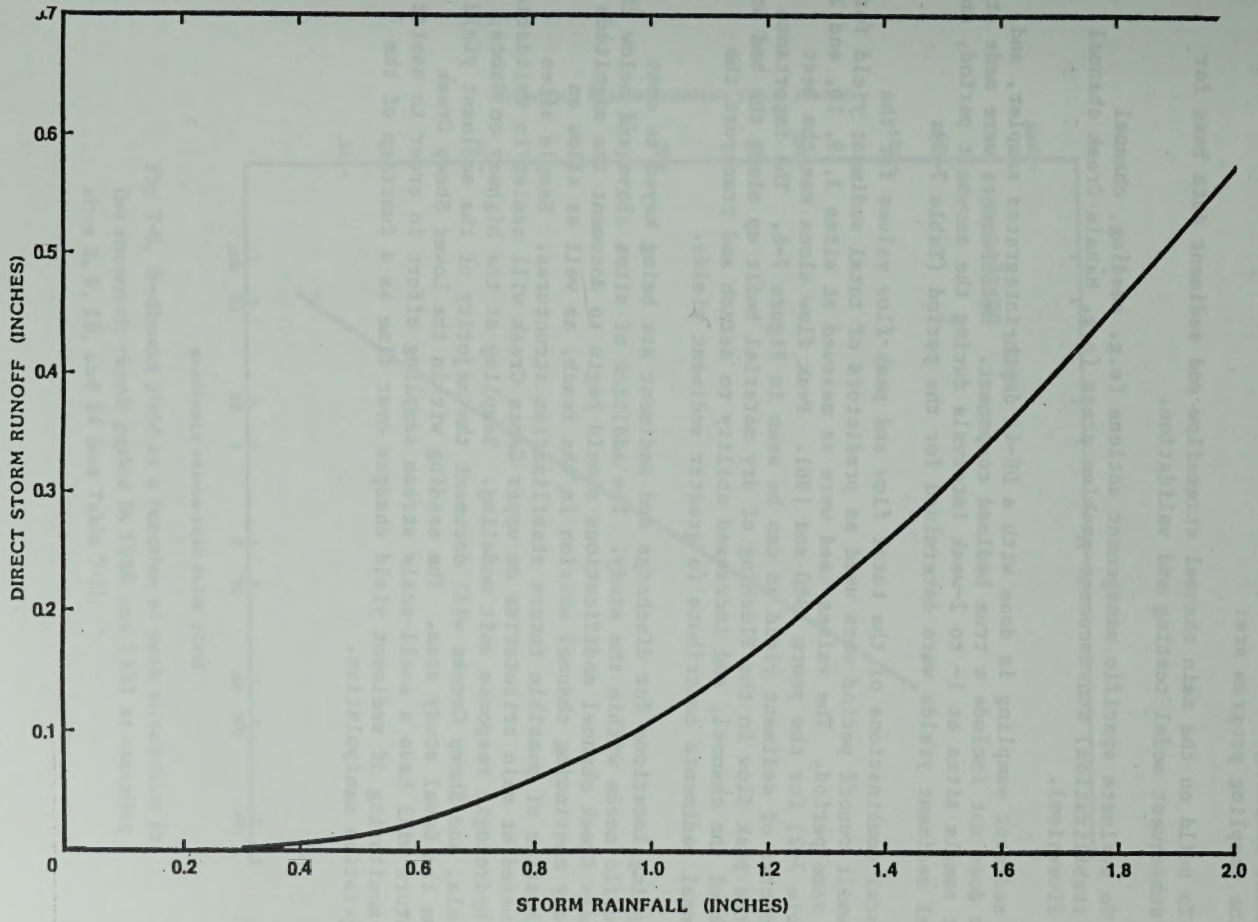

Fig. 7-5. Upper Gance and Upper Mahala Creek runoff as a function of rainfall using the SCS runoff curve number method.

WATER QUALITY

The water quality sampling effort in 1981 was reduced to periodic suspended sediment sampling concurrent with streamflow measurements. The objectives of the sampling program are:

1. To build on the main channel streamflow and sediment data base for subsequent model testing and validation.

2. To evaluate specific management actions (e.g. seeding, channel stabilization) and document problem areas (e.g. Mahala Creek channel diversion).

The sediment sampling is done with a DH-48 depth-integrated sampler, and thus does not include a true bedload component. Measurements were made at most sample sites at 1- to 2-week intervals during the snowmelt period, and total sediment yields were determined for the period (Table 7-2).

Several combinations of the total flow and peak flow values for the snowmelt runoff period were used as predictors of total sediment yield for the same period. The values used were as measued at sites 3, 9, 18, and 24 (Table 7-2) for the years 1980 and 1981. Peak flow alone was the best predictor of sediment yield as can be seen in Figure 7-6. The importance of the peak flow in the flushing of dry material built up along the bed and bank of the channel, and increased ability to detach and transport the channel sediments contribute to greater sediment yields.

Sampling locations for discharge and sediment are being keyed to meet specific needs within the study. The addition of sites above and below the Mahala Creek channel modifications should begin to document the magnitude of any continuing channel erosion in the reach, as well as allow an evaluation of possible future stabilization structures. Sample sites situated at main tributaries on upper Gance Creek will assist in validation of hydrologic response unit modeling. Sampling at the highway on Gance, Mahala, and Sheep Creeks will document the majority of the sediment yield from the Saval study area. The seeding within the Lower Sheep Creek pasture will have a small-scale stream sampling effort in order to assist in monitoring of sediment yield changes over time as a function of the vegetation manipulation.

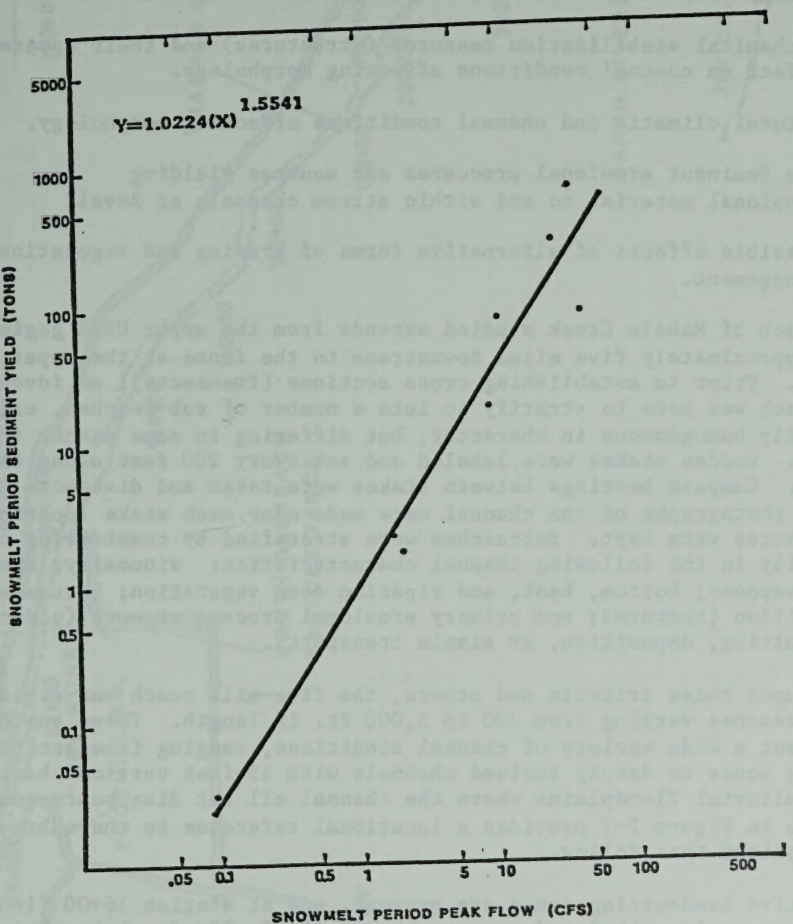

Fig. 7-6. Sediment yield as a function of peak streamflow for the snowmelt runoff period in 1980 and 1981 at sampling sites 3, 9, 18, and 24 (see Table 7-2).

MAHALA CREEK STREAM SURVEY

Last spring (1981), after discussions between UNR and BLM-DSC personnel, a number of possible stream channel related research opportunities were presented to the steering committee for consideration. It was generally agreed that, during FY 81, a number of semi-permanent cross sections would be measured and monumented along a five-mile reach of Mahala Creek. The purpose of this aspect of the program is to document changes in channel morphology with time to allow possible future evaluations of:

1. Mechanical stabilization measures (structures) and their apparent effect on channel conditions affecting morphology.

2. Natural climatic and channel conditions affecting morphology.

3. The dominant erosional processes and sources yielding erosional material to and within stream channels at Saval.

4. Possible effects of alternative forms of grazing and vegetation management.

The reach of Mahala Creek studied extends from the upper USGS gaging station approximately five miles downstream to the fence at the upper Tremewan Meadow. Prior to establishing cross sections (transects), an inventory of the reach was made to stratify it into a number of sub-reaches, each basically homogeneous in character, but differing in some manner from the others. Wooden stakes were labeled and set every 200 feet along the stream. Compass bearings between stakes were taken and distances were paced, photographs of the channel were made near each stake location and field notes were kept. Subreaches were stratified by considering changes primarily in the following channel characteristics: sinuosity, bank height and steepness; bottom, bank, and riparian zone vegetation; bottom and bank composition (texture); and primary erosional process at work (sidecutting, down-cutting, deposition, or simple transport).

Based upon these criteria and others, the five-mile reach was divided into 15 subreaches varying from 200 to 5,000 ft. in length. These subreaches represent a wide variety of channel conditions, ranging from active headcutting zones to deeply incised channels with 15-foot vertical banks to broad alluvial floodplains where the channel all but disappears completely. The map in Figure 7-7 provides a locational reference to the subreach descriptions that follow.

Two active headcutting zones are present, one at station 16+00 (1600 ft. down from gaging site) and one at station 43+00, 500 ft. below the foothill road crossing. These two areas are apparently the only zones of active down-cutting and probably represent the source of a large portion of the sediment transported through the five-mile reach. The upper 1/3 of the reach can be classified as generally erosional in nature: vertical raw banks, sometimes approaching 15 ft. in height are prevalent and rather unstable. Lateral cutting, as the stream seeks to establish a meandering course, is active, with associated bank slumping and raveling. The lower

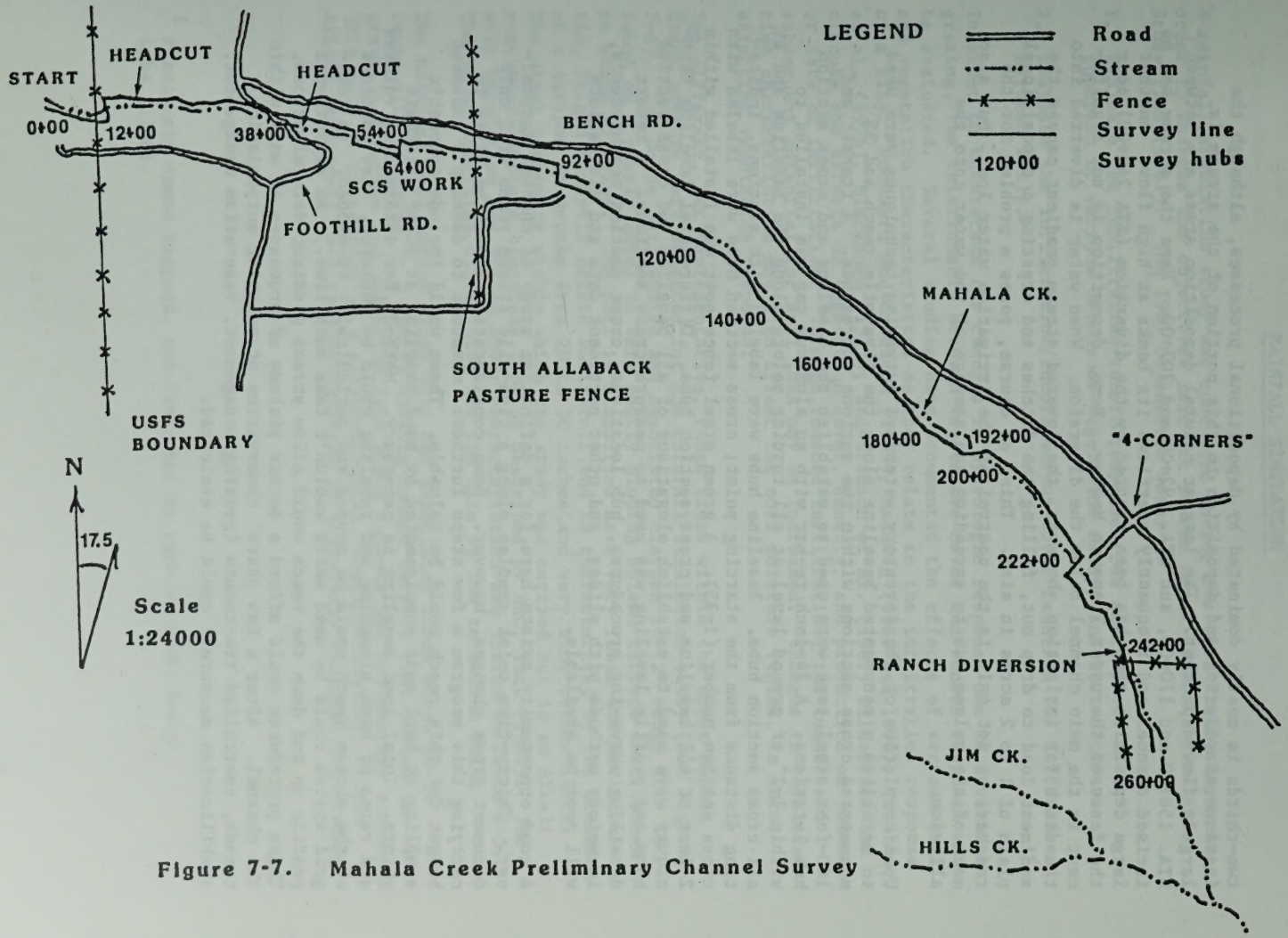

Figure 7-7. Mahala Creek Preliminary Channel Survey

two-thirds is mostly dominated by depositional processes, although the instance of scouring and deposition in this portion of the stream is largely flow-dependent. The largest natural deposition areas are between STA. 158+00 and 170+00, and STA. 192+00 and 207+00. Here the stream has no incised channel and frequently overflows its banks at high flow. Another large deposition area has been created by the diversion (STA 242+00) near the fence at the upper Tremewan Meadow. Here, deposition is not significant in the main channel below the diversion. When water is diverted into the ditch for irrigation, however, the lowered stream gradient causes the sediment load to drop out, filling the ditches and creating a depositional plain of 1 to 2 acres in size. This, of course, poses a problem for the rancher, as not only is the control of the irrigation water lost, but also much of the volume due to spreading and seepage of the water into the alluvium.

Upon completion of the inventory, standard surveying techniques were used to establish a monumented baseline along the five-mile reach and 35 monumented cross sections within the various subreaches. A transit and 100-foot steel tape were used to establish the baseline and cross section hub locations. A 24-inch re-bar with an aluminum cap was installed to within 1-2" of ground level at all turning points along the baseline and at all cross section hubs. Baseline hubs were labeled with stations, indicating distance from the starting point; cross section hubs were labeled with cross section number (1-35). A green steel fence post was installed within 2 feet of all baseline and cross section hubs. Differential leveling techniques were used to establish elevations of all baseline and cross section hubs and profile leveling was used to measure cross sections. A report detailing surveying procedures, hub locations, cross section measurements, inventory methods with slides, and other pertinent data and discussions will soon be available.

A good opportunity exists here for a definitive study of channel morphology. Thirty-five point samples along a five-mile stream reach will only document gross changes, however. Some consideration should be given to carrying this program a few steps further: measures to develop a sediment budget for this reach would be valuable. These would include automatic sampling at both ends supplemented by hand sampling at other strategic points. Total load sampling is necessary. Methods for determining volumes and rates of bank sloughing and raveling could be employed. Key portions of the stream reach would be mapped and periodically re-mapped. (A semi-grid system could be used which wouldn't take much time.) An elevational profile up and down the reach would allow stream gradient determinations. These procedures would afford a better picture of processes at work within the channel. After a few years' observation of existing morphological trends, controlled treatments (grazing management, vegetation management, stabilization measures) could be evaluated.

RAINFALL SIMULATION

A rainfall simulation study was conducted during the 1981 field season in order to address the objectives laid out in the Saval Rainfall Simulation Study Plan (1981). The 1981 objectives were:

1. Evaluate the infiltration/runoff response from small plots as a function of various levels of vegetation canopy and litter cover.

2. Evaluate the infiltration/runoff versus cover function for differences between soils.

In order to understand the changes in hydrologic response due to livestock grazing, the relationship between vegetative cover and runoff response must be evaluated. Several studies have documented the effects of various soil and vegetation characterisitcs as they relate to the infiltration response of a site. Woodward and Craddock (1945), Meeuwig (1965 and 1970), Tromble et al. (1974), Blackburn (1975), and Branson et al. (1981) illustrate and discuss the effects of vegetation cover, density, and production on volume or rate of infiltration. Through reduced infiltration, the runoff and subsequent potential for soil loss may be increased. Changes in infiltration characteristics may also affect the soil moisture regime, in turn, affecting vegetation response.

Two different, yet representative, range sites within the upper Mahala Creek pasture were selected for the rainfall simulation study (see Figure 7-1). The Donna soil series and associated claypan 10-12" range site is found on a nearly level to very gently sloping upland terrace that formed in mixed alluvium. The soil is classified as a very fine, montmorillonitic, frigid Abruptic Aridic Durixeroll and is characterized by the presence of a duripan at depths from 20 to 30 inches and very slow permeability. The plant community within which the study was carried out is an Alkali sagebrush/Sandberg bluegrass type as described by NRC, Inc. (1981). The site vegetation and ground cover characteristics are listed in Table 7-5. The range condition class (SCS) for the site is low to medium fair.

The McAffee[1] soil series study site and associated loamy slope 10-14" range site is found on a gently sloping upland terrace that formed in gravelly alluvium and colluvium from mixed igneous and sedimentary sources. This soil is classified as a clayey-skeletal, montmorillonitic, frigid Aridic Argixeroll, and is characterized by a gravelly cemented substratum

[1] Previously named Baggard, and described as such by Front Range Labs (1980).

Table 7-5. Mean percent canopy cover, by species, of major shrubs, grasses, and forbs, along with various ground cover characteristics on the Donna and McAffee study sites.

Donna		McAffee	
Shrubs	11.0		20.0
Alkali sagebrush	8.1	Mountain big sagebrush	9.6
Green rabbitbrush	1.5	Antelope bitterbrush	5.8
Antelope bitterbrush	1.0	Green rabbitbrush	4.9
Grasses	7.6		7.0
Sandberg bluegrass	4.1		3.4
Squirreltail	3.0		2.8
Thurber needlegrass	0.2		0.3
Idaho fescue	0.1		0.2
		Great Basin wildrye	0.2
		Bluebunch wheatgrass	0.1
		Cheatgrass[1]	-
Forbs[2]	3.0		2.5
Crag aster		Arrowleaf balsamroot	
Desert phlox		Tailcup lupine	
Longleaf phlox		Astragalus species	
Penstemon species		Gilia species	
Bare ground	29.4		23.8
Non-persistent litter	9.2		22.3
Persistent litter	4.1		10.0
Pebble(<½" dia.)	17.6		9.5
Stone(>½" dia.)	1.6		1.0

[1]Although it has extensive occurrence throughout the McAffee study site, % of cheatgrass cover was not determined due to the time of the field study and difficulty in differentiating current year's growth from the previous year's.

[2]Forb cover on both sites varies greatly in abundance and composition from year to year, depending upon amount, distribution, and season of precipitation. This fact, along with the problem addressed in the preceding footnote, made objective cover estimates of individual species unrealistic. Therefore, forbs on each site are listed in order of relative abundance.

and slow permeability. The plant community is a mountain big sagebrush/ antelope bitterbrush/green rabbitbrush type (NRC Inc., 1981), with cover characteristics as described in Table 7-5. The condition class (SCS) of the site is fair.

Plot locations within each site were selected based on ranges in total vegetative cover. All plots for each particular soil were within approximately 150 ft of each other, in order that soil profile characteristics, exclusive of the immediate soil surface, could be considered essentially constant between plots. Thirty-eight and fifty plots were utilized in the analysis for the Donna and McAffee soils, respectively.

All plots were situated within the interspace areas between shrubs. Studies have shown that the coppice dune, the area of accumulated litter and soil under shrubs and bunch grasses, typically has a much higher infiltration capacity than the surrounding interspace area between the shrubs (Blackburn, 1975; Blackburn and Skau, 1974). Though the dune area under a shrub may be a better micro-site than the interspace areas, the removal of forage from underneath these shrubs will not significantly reduce the total vegetative cover when viewed from above. Most sagebrush plants are typically utilized to a very small extent by livestock; thus their canopy cover remains relatively unchanged (Blackburn et al., 1980). Since livestock will have a minimal effect on the hydrologic response from the shrub-dune area on an upland site, the only remaining area to receive potential impacts is the interspace. In order to begin characterizing the effects of livestock use on an area, an adequate understanding of how their utilization affects the interspace areas is required. For this reason the initial study consisted of rainfall simulation runs on ranges of vegetation cover within the interspaces.

A drop-former type rainfall simulator patterned after Blackburn et al. (1974) was utilized. The plot was 6.25 ft^2 in area, and the intended rainfall application rate on each plot was 2.5 in./hr. A portion of the rainfall applied throughout each run was measured, allowing a more accurate determination of rainfall intensity for each run. Rainfall was continued for 60 minutes after runoff began. Runoff from each plot was measured volumetrically at given time intervals, and infiltration at any point in time was calculated as the difference between water applied and runoff measured. Actually, the calculated infiltration includes applied water that is intercepted by vegetation, water held in surface depressions, and water moving across the plot surface at the moment that the runoff is measured.

Typically, a "dry" and a "wet" run are made on each plot for infiltration studies, but in this situation one extended "dry" run was made. This length of run should be adequate to allow the upper portion of the soil profile to exert its effects on the typical runoff characteristics from the plot. A "wet" run final infiltration capacity would rarely be encountered in the natural situation on the study area; thus, it was felt dry run infiltration characteristics would be adequate for the evaluations.

To objectively determine a final infiltration rate for each rainfall simulation run, a function was needed which could be easily fit to the typical decay curves that resulted. Horton's equation (1940) is basically an empirical function which can be fit with a non-linear least squares program (BMDP, 1979) to produce both a decay-related constant and a final minimum value for the curve. Horton's equation is written as

$$f_t = f_c + (f_o - f_c)e^{-kt}$$

in which f_t is the infiltration rate in inches per hour at time t minutes after infiltration begins, f_c is the final infiltration rate, f_o is the initial infiltration rate at time zero, k is the decay constant defining the steepness of the die-off portion of the curve, t is time in minutes after infiltration has begun, and e is the base of the Naperian logarithm.

Theoretically, f_c is the value which should be reached as t approaches infinity, and should also correspond to the saturated hydraulic conductivity of the least permeable soil layer. In reality, a fairly long time is needed to actually reach this value for most soils, and the 60 minute runs employed in this study will likely not result in this value being reached. Still, the infiltration curve typically leveled off to a point where a smooth curve could be fit, and a value for f_c was determined for each plot. The values were subsequently evaluated with respect to above ground characteristics such as vegetation, litter, and rock cover.

Plant cover and composition, bare ground, persistent and non-persistent litter, pebble, and stone (<1/2 in. and >1/2 in. diameter, respectively) were measured on each plot using the point frame technique (Levy and Madden, 1933). A transect of 10 points across the plot was made at 3-inch intervals moving up the plot, resulting in a total of 100 points per plot.

Antecedent soil moisture and bulk density for the surface 3 inches were determined gravimetrically at points immediately outside of the plot boundaries. The antecedent soil moisture for each plot was typically very dry; in the range of 5 to 15 percent by weight.

Table 7-6 is a summary of the statistics for the variables used in the analyses. Variables X1 through X7 were measured on each plot, and variables X8 through X11 are combinations of these. As indicated, there is a significant difference between the mean final infiltration rate on the two soils. The only independent variables showing significance between soils are percent bare ground and percent non-persistent litter. As can be seen the mean total vegetative cover for all plots is not significantly different between the two soils. Further analysis indicates the effects on infiltration rate of different amounts of vegetative cover and litter within a particular soil.

The rainfall simulation plots were selected in such a way as to sample a range of vegetative cover percentages. For analysis of cover effects, the plots were grouped based on the percentages of vegetative cover and

Table 7-6. Variables used in analysis with associated means and standard deviations.

	Variable (units)	Mean (n=38)	Standard Deviation
	Donna Soil		
Y1	Horton's K	-0.12	0.12
Y2	Horton's Fc (in./hr)	0.85*	0.43
Y3	Water uptake prior to runoff (in.)	0.37	0.22
X1	Vegetative cover (%)	17.24	12.32
X2	Vegetative basal cover (%)	6.12	5.77
X3	Bare ground (%)	59.78*	14.47
X4	Litter (non-persistent)(%)	9.77*	6.27
X5	Litter (persistent) (%)	3.43	4.55
X6	Pebble (<1/2 in. diam.) (%)	7.11	5.01
X7	Stone (>1/2 in. diam.) (%)	2.67	2.93
X8	Veg. cover + all litter (%)	30.44*	16.50
X9	Veg. cover + all litter + all rock (%)	40.22*	14.42
X10	All litter (%)	13.20*	8.20
X11	All rock (%)	9.78	7.46
	McAffee Soil		
		(n=50)	
Y1	Horton's K	-0.11	0.13
Y2	Horton's Fc (in./hr)	1.52*	0.60
Y3	Water uptake prior to runoff (in.)	0.37	0.20
X1	Vegetative cover (%)	16.78	11.91
X2	Vegetative basal cover (%)	4.06	4.50
X3	Bare ground (%)	34.96*	14.11
X4	Litter (non-persistent)(%)	33.75*	12.67
X5	Litter (persistent) (%)	3.77	3.87
X6	Pebble (<1/2 in. diam.) (%)	8.11	10.74
X7	Stone (>1/2 in. diam.) (%)	2.68	4.53
X8	Veg. cover + all litter (%)	54.30*	18.97
X9	Veg. cover + all litter + all rock (%)	65.08*	14.04
X10	All litter (%)	37.52*	12.84
X11	All rock (%)	10.78	13.52

* Indicates means for the particular variable are significantly different ($\alpha = 0.05$) between the two soils.

percentages of vegetative cover plus persistent and non-persistent litter cover. The cover groups used for the analyses consisted of 10 percent intervals, except when only one sample fell into an interval, in which case two intervals were lumped.

A two-way analysis of variance (AOV) on final infiltration rates indicates that there is a significant effect due to the two different soils as well as to the vegetation cover groups. No interaction between soil and cover is indicated. One-way AOV's were done for each soil separately and Fisher's Least Significant Difference (LSD) test for multiple comparisons was used to determine which cover intervals resulted in significant differences in final infiltration rates. Different groupings of cover percentages can result in different outcomes from the LSD test. As the cover intervals become finer the sample size decreases, meaning that there must be a larger difference between group means before they are considered significantly different. The mean final infiltration rates for each cover interval for each soil are given in Table 7-7.

The trend in most instances is for the final infiltration rate to increase with increasing cover amounts. The major discrepancy is on the Donna soil in the vegetation cover comparisons. In this instance the mean infiltration rate still generally increases with vegetative cover, but some of the means appear not to be in order. Some of this is likely due to the fact that several different plant species were encountered within the plots, and some of the species had greater amounts of litter associated with them than others. Two plots containing the same percentage of vegetative cover could have vastly different litter amounts, and thus different total cover percentages.

The effects of litter can be seen when the variables vegetative cover and all litter are added together and used as total cover (does not include pebble or stone cover). The range in total cover on both soils increases and the trend in mean infiltration rates for the total cover intervals tends to smooth out.

The data were evaluated through stepwise regression, with the resulting equations for infiltration rate for the two soils shown as (1) and (2) in Table 7-8. Vegetative cover plus all litter is the most important variable in explaining the variation in final infiltration rate for both soils. The equation for both soils combined is given as (3) in Table 7-8. The regression lines are plotted in Figure 7-8. By comparison the regression lines for final infiltration rate as a function of vegetative cover only are plotted in Figure 7-9.

Table 7-7. Mean infiltration rates and water uptake volumes for various cover percentages.

FINAL INFILTRATION RATE

% veget. cover	0-10	10-20	20-30	30-40	40-50	50-60
Donna	0.541a	0.920b	0.850ab	1.481c	1.108bc	
McAffee	1.095	1.591a	1.749a	1.950a	2.013a	

% veget. cover plus litter	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Donna	0.431a	0.540a	0.725ab	0.967bc	1.163cd	1.161cd	1.618d			
McAffee	0.653a		1.053ab	1.164ab	1.191ab	1.501bc	1.806cd	1.987cd	- 2.190d	

WATER UPTAKE PRIOR TO BEGINNING OF RUNOFF

% veget. cover	0-10	10-20	20-30	30-40	40-50	50-60
Donna	0.333	0.400	0.389	0.390	0.383	
McAffee	0.291a	0.357a	0.371a	0.479a	0.737	

% veget. cover plus litter	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Donna	0.259	0.372	0.367	0.576	0.338	0.281	0.419			
McAffee	0.286		0.242	0.284	0.287	0.392	0.402	0.405	0.543	

Means followed by the same letter are not significantly different ($\alpha = 0.05$) as determined by Fisher's LSD test. All comparisons are made within a single soil and row.

Table 7-8. Stepwise regressions.

Equation No.	Soil	Regression Equation	R^2	F
		Final Infiltration Rate		
(1)	Donna	Y2 = 0.247 + 0.020(X8)	0.58	50.1
(2)	McAffee	Y2 = 0.367 + 0.021(X8)	0.47	41.7
(3)	Combined	Y2 = 0.223 + 0.023(X8)	0.63	145.3
		Water Uptake Prior to Runoff		
(4)	Donna	Y3 = 0.481 - 0.011(X11)	0.13	5.5
(5)	McAffee	Y3 = 0.282 + 0.021(X2)	0.22	13.2
(6)	Combined	Y3 = 0.298 + 0.015(X2)	0.13	12.7

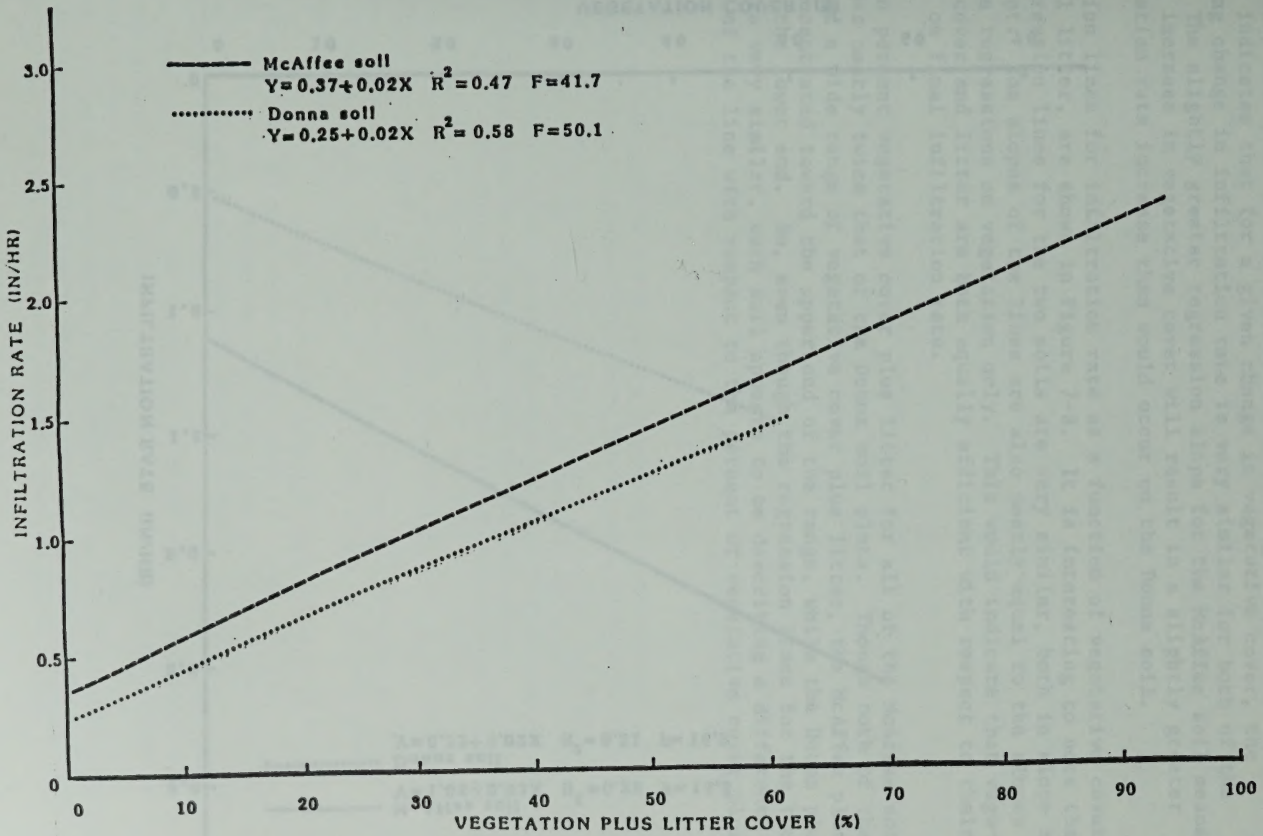

Fig. 7-8. Infiltration rate as a function of vegetation plus litter cover on the McAffee and Donna soils rainfall simulation sites.

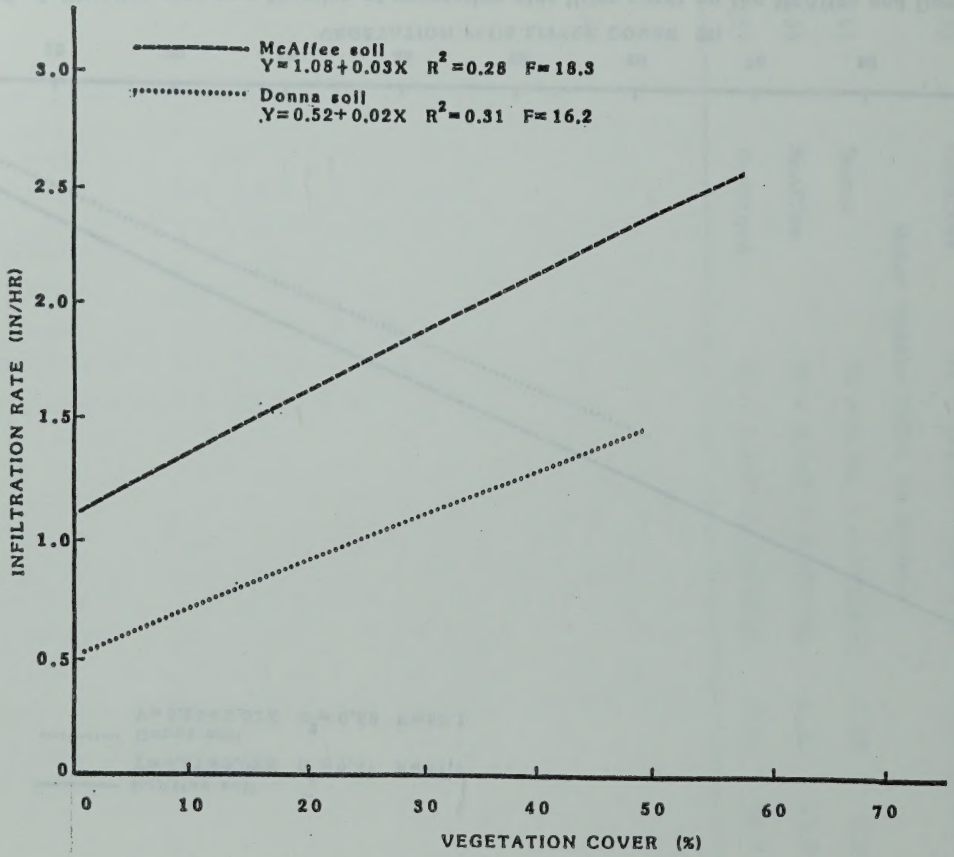

Fig. 7-9. Infiltration rate as a function of vegetation cover on the McAffee and Donna soils rainfall simulation sites.

The mean and standard deviation for vegetative cover alone are essentially the same on both soils, but the infiltration rates are significantly different. As can be seen in Figure 7-9, the slopes of the two regression lines are very similar, while the intercept for the Donna soil is essentially half that of the McAffee soil. The fact that the slopes are similar indicates that for a given change in vegetative cover, the resulting change in infiltration rate is very similar for both of the soils. The slightly greater regression slope for the McAffee soil means that an increase in vegetative cover will result in a slightly greater infiltration rate increase than would occur on the Donna soil.

Regression lines for infiltration rate as a function of vegetative cover, plus all litter, are shown in Figure 7-8. It is interesting to note that the regression lines for the two soils are very similar, both in slope and intercept. The slopes of the lines are also nearly equal to the slopes from the regressions on vegetation only. This would indicate that vegetative cover and litter are both equally efficient with respect to their effects on final infiltration rate.

The mean percent vegetative cover plus litter for all of the McAffee soil plots was nearly twice that of the Donna soil plots. Though both of the soils had a wide range of vegetative cover plus litter, the McAffee plots were concentrated toward the upper end of the range, while the Donna plots were at the lower end. So, even though the regression lines for the two soils are very similar, each soil appears to be describing a different portion of the line with respect to the percent of vegetative cover plus litter.

Summary and Conclusions

Baseline data gathering was continued in 1981 with respect to precipitation, water quality, streamflow and sediment yield. Precipitation and runoff were much lower in 1981 than 1980, but annual runoff showed a much greater decrease than did annual precipitation.

Flood frequency relationships were calculated allowing future comparision to possible long-term forecasts for testing and validation of the hydrologic component of forage production and other system models.

Following their selection and instrumentation, data collection was initiated on two small watershed basins. Further instrumentation and monitoring of these and subsequent basins will increase the data base for evaluation of livestock treatments on the hydrologic responses of various range sites.

Modeling efforts have been initiated within the hydrology program for evaluation and application. The effects of different livestock management treatments will be predicted, tested, and evaluated with regard to the hydrology studies.

The Mahala Creek stream survey will begin to provide a set of baseline channel morphology information. Once existing morphological trends are established, various management schemes can be evaluated with regard to their impacts.

The rainfall simulation study evaluated the effects of vegetation canopy cover and litter cover upon infiltration/runoff response on two different soils. Data analysis showed a significant difference between the mean final infiltration rate on the two soils. The final infiltration rate generally increases with increasing amounts of vegetation and litter cover on the two soils. Vegetation and litter also appear to be equally efficient, in terms of their effects on final infiltration.

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CHAPTER 8.

LIVESTOCK RESEARCH

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Species Composition of Rumen Fistulated Cattle Diets

1980 Objective:

Determine the species composition of forage consumed by rumen fistulated cattle on the South Alabach and North Forest Service pastures.

1980 Accomplishments:

Range forage was consumed by four rumen fistulated steers from May 30 to June 10, 1980, on native range (South Alabach pasture) and again from August 1 to August 11, 1980, on Forest Service range (North Forest Service). Rumen samples were taken from each animal 3 to 4 times during each of the 10-day periods. A portion of each sample was sent to the Composition Analysis Laboratory, Colorado State University, for microscopic analysis. Results from this analysis were not received until June, 1981, and therefore were not available for the 1980 progress report. Results from the 1981 field season samples have not been received in time for this progress report.

Percent relative density of discerned fragments from cattle rumen samples is shown in Table 8-1. The diet of fistulated cattle grazing the South Alabach pasture consisted of 95% grass or grass-like forage. Botanical analysis identified brome, bluegrass, wheatgrass, and bottlebrush squirreltail as the more important grass species. The identified brome, bluegrass, and wheatgrass were most likely cheatgrass, Nevada bluegrass and bluebunch wheatgrass, respectively. This diet contained 60% upland species and 35% meadow forage species.

Forbs were only found in trace amounts in the diet. This could be due to the preference for grass by cattle during a lush vegetation year. Big sagebrush constituted 1% of the diet with antelope bitterbrush found in trace amounts. The presence of these shrubs in the diet during this time of year was probably due more to curiosity than preference.

The late summer diet (North Forest Service pasture) showed a decrease in total grass or grass-like forage to 81 percent. However, a dramatic increase was seen in wet meadow grass-like forage. Sedges and rushes made up 55% of the diet with the percentage of upland forage decreasing to 14 percent.

The percentage of forbs increased from trace amounts to 12% of the diet. This increase may be explained by the differing types and/or availability of forbs in this area as compared to the South Alabach pasture. The Colorado State University botanical analysis identified strawberry as composing 9% of the diet. As strawberry is not known to be in this area, we suspect this may have been a cinquefoil. Utah serviceberry and antelope bitterbrush constituted 4% of the cattle diet. As the main cow herd had not previously grazed in this area, the relatively small percentage of shrubs within the diet could be due to the abundance of still palatable grass and grass-like forage.

Table 8-1. Percent relative density of discerned fragments of important species in cattle rumen samples collected during the 1980 field season.

Species	South Alabach Pasture	North Forest Service Pasture
Grass and grasslike		
Agropyron	15	4
Agrostis	T	0
Bromus	20	3
Carex	10	42
Eleocharis	T	6
Elymus	4	T
Festuca	6	0
Hordeum	T	0
Juncus	8	13
Muhlenbergia	T	6
Poa	17	4
Sitanion hystrix	15	3
Total†	95	81
Forbs and Shrubs		
Achillea lanulosa	0	T
Amelanchier utahensis	1	0
Artemisia	0	3
Crepis acuminata	0	3
Cryptantha	T	0
Descurainia	0	T
*Fragaria**	0	9
Plantago seed	T	0
Purshia tridentata	T	T
Purshia tridentata seed	T	1
Verbascum thapsus	0	T
Total†	1	16

† T < 1%. Totals not equal to 100% due to trace amounts and rounding to whole numbers.

* *Fragaria* may be *Potentilla*.

In summary, the cattle diets contained a greater percent of grass and grass-like forage in both the South Alabach (early) and North Forest Service (late) diets. However, the upland grass species constituted a greater percentage in the earlier diet with meadow species becoming the more important forage in the later diet. Forbs and shrubs also became more important during the later period. This change in preference to meadow forage, forbs, and shrubs could be due to their higher crude protein content.

Diet Quality and Amount of Forage Consumed by Range Cattle

1981 Objective:

Determine the nutritional quality and amount of forage consumed by range cattle grazing Saval Ranch pastures.

1981 Accomplishments:

Range forage was sampled by 4 rumen fistulated and 4 intact steers on upper BLM native range (Upper Sheep Creek pasture) and on Forest Service range (North and South Forest Service pastures). The steers sampled each pasture for 9 days before the main cow herd grazed the areas and again for 9 days after the main herd had been removed. The sampling periods were as follows: Upper Sheep Creek, May 7-15 and June 8-16; North Forest Service, May 23-31 and August 6-14; and South Forest Service, July 14-21 and October 1-9, 1981. The steers grazed approximately 6 hours each day and were kept in a corral at night. Rumen forage samples were collected from the fistulated animals during 3 days of each 9-day period. The intact steers were bolused twice a day with the external indicator chromic oxide. Fecal grab samples were collected twice daily on days 4 through 9 of each period. Rumen and fecal samples were chemically analyzed in the Animal Science Nutrition Testing Laboratory at the University of Nevada, Reno, for percent crude protein, acid detergent fiber and lignin. In addition, fecal samples underwent analysis for percent chromic oxide.

Results from the chemical analysis, calculated digestibility and intake values from rumen and fecal samples are shown in Table 8-2. Pooled protein levels for the early and late sampled diets from each individual pasture decreased as the animals grazed the Upper Sheep Creek, North Forest Service, and South Forest Service pastures. Higher protein values were found in the diets collected during the earlier sampling periods for each pasture. Overall, the total protein level in the diets would appear to meet a range cow's protein requirement.

Acid detergent fiber (ADF) within the diets decreased 2% for each pasture. Since the percent ADF increases as a plant matures, it would be expected that the percent ADF would increase in the diets collected from areas grazed at a later time during the year. Since this is not shown in the above data, it would suggest that the animals selected for less fibrous forage species or less fibrous portions of the plants. However, as the total difference between the greatest and the least fibrous diet was only 4%, further research is needed in order to be conclusive. Results from botanical analysis of these diets may indicate whether species selection is a factor. The percent ADF was lower in the diets collected during the earlier sampling period for each pasture.

Grazing animal diets increased in lignin on those pastures grazed later in the season. In the areas where samples were taken before and after the main herd, percent lignin was higher in the later samplings as lignin gradually increases with maturity of the plant tissue.

Table 8-2. Chemical analysis, calculated digestibility and intake values from rumen and fecal samples collected on Saval pastures.

Area	Chemical Tests			Digestibility and Intake Values			
	Total crude protein	Acid detergent fiber	Lignin	Digestible crude protein	Digestible dry matter	Intake	Intake
	(%)	(%)	(%)	(%)	(%)	(lb/day)	(% body wt)
Upper Sheep Creek	13.2	42.3	13.0	7.4	46.1	10.1	1.45
North Forest Service	11.2	40.0	15.4	4.8	44.2	9.4	1.36
South Forest Service	8.8	37.9	17.8	2.6	45.0	10.5	1.51
Early sampling period, all pastures	13.6	35.0	12.9	7.4	50.9	7.6	1.09
Late sampling period, all pastures	8.5	45.1	17.8	2.4	39.3	12.3	1.78

Percent digestible protein, like total protein, decreased in the diets from the later grazed pastures. The diets sampled from the second grazing period of each pasture contained less digestible protein than was found in the earlier grazing period. This lower protein level during this time coincided with a higher percent lignin. This may be explained in that lignin and fibrous fractions of the forage interfere with the digestibility of other nutrients including protein. The digestible protein level in the later sampled diets bordered on not meeting animal requirements. However, as the values are so close, protein supplementation is not recommended at this time.

Less than a 2% difference was found in digestible dry matter between pastures. A much greater difference was found between the early and late sampling periods. As with protein, the lower percent digestible dry matter corresponded with a higher percent lignin during the later sampling period. This high negative correlation between lignin content and digestibility is particularly true for grasses. It is difficult to compare or contrast the digestible dry matter between the 1980 and 1981 diets as the samples were collected in different areas during different times. However, the 72 and 55 percent digestibility for diets collected from the South Alabach pasture in early June and from the North Forest Service pasture in early August 1980, respectively, are greater than in any of the 1981 diets. This could be due to the earlier maturation of forage during 1981 as compared to the previous year.

The average dry matter intake ranged from 9.4 pounds per day (1.36% of body weight) to 10.5 pounds per day (1.51% of body weight). This is a slightly higher percent of body weight than was found for the previous year. The research animals consumed less during the earlier sampling period. This may be due to the animals unfamiliarity with the area. In the future, this may be corrected by using the same animals year after year and allowing the animals more time to familiarize themselves with the area and forage available prior to sampling.

In summary, percent total and digestible protein decreased in the diet as the animals grazed the Upper Sheep Creek, North Forest Service and South Forest Service pastures. The protein levels in the earlier sampled diets were greater for all pastures. Percent acid detergent fiber, digestible dry matter and forage intake appeared to be similar in the pooled diets for each pasture while percent lignin increased. Higher ADF, lignin and intake values were found for the later sampled diets while digestibility decreased. The higher intake value was probably due to the animals increased familiarity with the area during the second sampling. Further research is necessary before any of these apparent trends can be verified.

An Evaluation of Cattle Production Factors

1981 Objective:

Evaluate some economically important animal production factors on the Saval Ranch.

1981 Accomplishments:

During the time calves were branded, vaccinated and castrated (May 18 and 20, 1981), a random sample of calves were also eartagged and weighed. The sample included 100 calves of which 50 were female and 50 were male. The respective weights of the 2 groups were 134 and 143 pounds (Table 8-3). There was no significant difference between these weights nor between the calf weights taken at a similar time during 1980 and these 1981 calf weights. However, as birth rates were not known for these calves, the weights were not correct for age of calf. The random sampling of calves should help to negate this effect.

The calves were again weighed at the time of their weaning (October 5-21, 1981). The mean weight for heifer calves was 338 pounds and 339 pounds for Ralgro implanted steers (Table 8-4). No significant difference was found between these weights. Mean weights for the entire weaned calf crop reported by the Saval Ranch manager, were 315 and 340 pounds, respectively, for heifer and steer calves. The sampled calves weaned in October, 1980, were significantly ($P < 0.05$) heavier than 1981 weaned calves. The 1980 calves gained 1.56 pounds per day between May and October. The 1.35 pounds per day gain for the 1981 calves during the similar time period was significantly ($P < 0.01$) less.

On November 21, 1980, 100 cows of different breed types and sizes, diagnosed as at least 3 months pregnant, were eartagged and weighed. The mean weight for the cows was 802 pounds. These cows were again weighed and pregnancy tested on October 6-23, 1981. The cows weighed 778 pounds, significantly ($P < 0.01$) less than in November of the previous year. As mentioned in the diet quality section of this progress report, the protein level in the diet did not always meet the animal requirement. This alone may not explain the lower cow weights for 1981. The energy level in the 1981 diets was only 71% of the energy level in the 1980 diets. This along with the low protein in later 1981 diets could explain the weight difference. This may also be another reason for the lower weaning weights for 1981. Inadequate protein and/or energy during lactation will cause a decrease in milk production, resulting in smaller calves.

Thirty-nine percent of the sampled cows were diagnosed as pregnant while the main cow herd contained 44% pregnant cows. Adequate nutrition is particularly important during the late winter months since high fertility

Table 8-3. May 1980 and 1981 calf weights by sex[a]

Sex	May 5, 1980		May 18 and 20, 1981	
	Number of calves	Calf weight	Number of calves	Calf weight
		(pounds)		(pounds)
Heifer	25	148	50	134
Steer	24	145	50	143

[a]Calf weight differences were not significant between the two years and sexes. Calf weight represents mean value.

Table 8-4. October 1980 and 1981 calf weights by sex[a]

Sex	October 15, 1980		October 5-21, 1981	
	Number of calves	Calf weight	Number of calves	Calf weight
		(pounds)		(pounds)
Heifer	25	373	49	338
Steer	24	384	48	339
Total	49	378*	97	338

[a]Calf weight differences were not significant between sexes. Calf weight represents mean value.

*$P < 0.05$.

is a function of adequate protein and energy levels. Cows receiving inadequate protein and/or energy during preparturition will not come into estrus as early and conception after the first estrus will be delayed. This delayed conception could result in a number of cows being considered not pregnant when possibly they were in a very early stage of gestation that was not detected during the pregnancy tests.

In summary, the sampled weaned calves and mature cows showed heavier weights in 1980 than in 1981. One possible explanation for the difference in weights could be inadequate protein and/or energy levels in the 1981 diet. The conception rate in October, 1981, was extremely low at 39 percent. Once again, inadequate protein and/or energy levels during the late winter months and early period following calving could cause this low fertility value.

CHAPTER 9.

ECONOMIC RESEARCH

Lee Garoian and Gordon Myer

1981 Objectives:

1. Collect useful data for economic analysis.
2. Analyze and develop resource allocation models.
3. Evaluate significance of livestock sector in Elko County.

1981 Achievements:

1a. Producer panels were conducted with Elko County ranchers. The information obtained from these panels consisted of management practices, production, and production cost data for a typical ranch in Elko Co. These data were published in a fact sheet entitled "Cost and Returns for Cow-Calf Enterprises in Elko Co., Nevada."

1b. Income and cost information was collected for the Saval Ranch. This information was prepared as a report titled "1980 Income Statement for the Saval Ranch." This paper reports the cost of producing hay, cost of raising livestock, and net farm income. Net farm income in this case is the return to owner's equity. Implications of the purposed grazing system on the future profitability of the Saval Ranch are briefly discussed. The conclusion is that positive exogenous forces may be necessary if the Saval Ranch is to become profitable.

2a. Linear programming is one of the more frequently used allocation techniques for range cattle studies. Until recently, the use of linear programming was limited to those with a thorough knowledge of these procedures. The development of COPLAN has increased the accessibility of linear programming.

The paper "A Critique of COPLAN - A Dedicated Ranch Optimization Model" was completed. This paper compares the results obtained from the traditional linear programming framework and COPLAN. It was found that the solution obtained from the general linear programming procedure was compatible with that of COPLAN. The reliability and ease of use make COPLAN a useful tool for range allocation studies. A limitation of COPLAN is that the solution refers to one point in time.

2b. Many of the problems faced by the rancher in decision making relate in an important way to time. Most analysis relates to a single time period. The rancher must depend on intuitive judgment as to how time would effect the single year solution. Multi-year linear programming is appropriate in these situations. The methodology for constructing static, multi-year, recursive, and dynamic linear programming models concerned with range cattle operations has been completed. This methodology is necessary for the analysis of the proposed grazing system.

2c. The importance of federal grazing makes it desirable to have a generally accepted procedure to account for grazing on federal land in linear programming models. A difficulty encountered when federal grazing activities are included in linear programming models is accounting for the actual number of AUM's supplied by the payment of grazing fees. The BLM and FS require that a grazing fee be paid for each livestock class, other than calves, when on federal land. The number of AUM's consumed by different livestock classes may vary. The difficulty of accounting for the variable number of AUM's obtained for BLM and FS grazing has caused considerable difficulty for linear programmers. A technique that removes this disparity was discussed in the paper "A General Procedure for Incorporating BLM and FS Grazing Activities in Linear Programming Models."

2d. A number of different techniques have been used to incorporate federal grazing activities in linear programming models. These techniques result in an inefficient (AUM/grazing fee) utilization of federal lands. The paper on the multiple grazing activities approach for including federal grazing discussed in Section 2c improves the efficiency of federal land usage in linear programming models. The economic implication of improved efficiency in the use of federal land is discussed in "An Analysis of Alternative Linear Programming Models for Range Livestock Grazing Activities on Public Land."

2e. A further development in resource allocation models concerns the cost of moving livestock from one forage source to another. The solution of linear programming models concerned with the range cattle industry normally indicates the optimal allocation of forage resources. The optimal allocation of forage is dependent on the cost of using each forage source. An important cost of using forage is the cost of moving livestock to the forage source.

Traditionally these costs have been added to the cost of raising livestock. This is not an adequate procedure for studies where the allocation of forage is an important consideration. In the paper "A Linear Programming Model for Including Transportation Costs Between Forage Sources by Livestock Class," a technique is developed for including transportation costs as a separate item. This method improves the accuracy and reliability of our analysis.

3a. The significance of the livestock sector can be studied with the use of Input-Output Models. The development of an inter-industry model for Elko Co. has been completed. This model is capable of determining how the ranching industry relates to other industries. This model is used to determine the impact that increases or decreases in cattle sales have on the total community.

CHAPTER 10

RESEARCH DESIGN, INTEGRATION, AND SYNTHESIS

ESSA, Ltd.

Objectives of the Work:

The objectives of the work conducted by Adaptive Environmental Assessments, Inc. (AEA) are to construct a systems model than will aid Saval Ranch Research and Evaluation Project (SRREP) to identify the significant hypotheses that should be tested to evaluate the impacts of the Saval Ranch Management Plan and to provide an integrated research plan for SRREP that can be iteratively modified as project results are assimilated. The research plan should maximize efficiency of research effort and interdisciplinary coordination.

Introduction:

The Saval Ranch Research and Evaluation Project is an interagency effort begun in 1978 through a cooperative agreement among the Bureau of Land Management (BLM), the Agricultural Research Service, the Forest Service, the Soil Conservation Service, and the owners of the Saval Ranch. The principal objective of the project is to evaluate the effects of the Saval Ranch Coordinated Management Plan, involving a livestock grazing system and a series of rangeland improvement practices, on vegetation and livestock production, fish and wildlife habitats and resources, and water quality. A secondary objective is to extend the lessons learned from the Saval Ranch to other rangeland management situations. To meet this objective, research will be conducted on the Saval Ranch for approximately 15 years, enough to allow for a complete grazing rotation cycle.

Research projects of this type are inevitably difficult to design and coordinate. The scope of SRREP touches on hydrology, animal science, rangeland management, economics, wildlife biology, and a host of other concerns. It also involves numerous agencies and individuals, each with particular perspectives, expectations, and biases. Although initially all research questions seem relevant and important to answer, careful structuring of the research is necessary under constraints of limited money and time.

To avoid costly, multidisciplinary research without synthesis and periodic reevaluation of research direction, BLM desired an integrated, interdisciplinary research plan for project managers and research scientists associated with SRREP. Adaptive Environmental Assessments, Inc. was contracted to assist in the development of the research plan.

Description of Work:

The work will span 2 1/2 years, from September, 1981 to February, 1982. The contract called for two modeling and integration workshops to be conducted within 6 months of contract award, and a series of smaller meetings between AEA and SRREP personnel over the following 2 years.

The first two workshops have been conducted. The first workshop, held in November, 1981, was the most labor and time intensive of the workshops to be carried out under the contract. The meeting lasted 5 days and involved five workshop staff and approximately 30 participants. The participants represented most of the agencies involved in SRREP and cross-section of disciplinary expertise required in the program. The initial Saval Ranch model was constructed at this workshop. The relevant data and

understanding of the participants concerning livestock, economics, soils, vegetation, hydrology, and wildlife were synthesized and then integrated into a model, giving an overall picture of the biophysical and economic dynamics of the Saval Ranch system. Of particular importance at the first workshop was the identification of those variables and parameters which link the various disciplines outlined above.

A substantial documentation and model refinement period occurred after the first workshop. Modifications to the model were made based on the responses of participants to the discussions at the first workshop and results of the first model. Refinements concentrated on better representing the relationship between disciplines, rather than on each particular discipline (e.g. the relationship between forage availability and quality and cattle growth, the relationship between soil water availability and plant growth, etc.).

The second workshop, in January, 1982, lasted 3 days and involved a smaller number of participants and staff. The explicit objective of the second meeting was to evaluate and modify 1982 research plans using the refined model as a means to test critical hypotheses about the Saval Ranch system. Particular consideration was given to the timing, frequency, and spatial extent of the data collections that would be needed to test the critical hypotheses.

Subsequent to the second workshop, a draft report, describing the work done to date and giving recommendations for the direction of future research and modeling efforts, was written. The report has been given to participants of both workshops for review.

Research Design:

There are two traditional approaches to conducting interdisciplinary research. The first is to monitor. Components of concern (indicators) are measured over time as the range management plan is carried out. The second is hypothesis testing. The response of indicators are measured in relation to specific management actions in an effort to reveal the underlying functional relationship between components of the system.

The latter approach is recommended for a number of reasons:

1) by examining functional relationships between different components (e.g. the growth *responses* of cattle to *changes* in forage availability and quality), the essential interdisciplinary connections between system components are studied. It is usually these interdisciplinary connections which become lost in a research project.

2) it is much easier to adapt and change the research design as the program proceeds and the understanding within SRREP about the Saval Ranch system changes and improves if functional hypothesis are being studied. Options in a monitoring-oriented research program invariable become foreclosed as a larger and larger data set is constructed through time.

3) transferability of the research results to other areas will be much easier and more relevant. For example, management plans for other ranches may involve different cattle stocking levels and rotation schemes, but the relationship between cattle growth and forage availability and quality (if defined and measured properly) will be the same.

Furthermore, the research must attempt to address the effects of specific management actions at a specific time and place, and then sum over all actions, times and places to get a picture of the cumulative effects of the management plan. Any single indicator is likely to be affected by only a few management actions. Research on any one component of the system can then focus on the few actions affecting that component; adding their effects becomes simple.

Given that the research must emphasize functional relationships between disciplines, cross-disciplinary communication becomes vital. There must be a consistent view among SRREP managers and research scientists of what constitutes needed research for SRREP to be effective and efficient. In order to ensure this consistency, the SRREP should place strong emphasis on:

1) promoting frequent dialogue among field researchers, and between field researchers and project management;

2) coordinating data collection activities among the different disciplines:

3) insuring compatibility among researchers in the way that components are measured and in the units of measure, and

4) making efforts to minimize interdisciplinary communication problems caused by semantic difficulties.

Ideally, the nature and design of the research will continue to evolve as some questions are answered and new ones become obvious. The model itself should help guide this evolution and, as new data surface and understanding improves, the model should become more realistic and useful as a management tool.

Future Directions:

The three shorter workshops yet to come will serve to review research findings, refine the model, and define new areas of needed research. In the short term, the model will be transferred to the SRREP. In addition, some obvious model improvements will be made, perhaps by transferring portions of the large model to microcomputers more easily accessible to research scientists and project managers. Also, consideration should be given to a data base management system. Particular consideration must be given to ensuring that the data base management system be structured to meet the interdisciplinary communication needs outlined above.

APPENDIX I

Species code and ground cover abbreviations used in vegetation tables

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Tree and Shrub Species	
AMUT	*Amelanchier utahensis*	Utah serviceberry
ARAR	*Artemisia arbuscula*	Low sagebrush
ARCA	*A. cana*	Silver sagebrush
ARLO	*A. longiloba*	Alkali sagebrush
ARTR	*A. tridentata*	Big sagebrush
CEVE	*Ceanothus velutinus*	Snowbrush ceanothus
CHRYS	*Chrysothamnus* spp.	Rabbitbrush
CHNA	*C. nauseosus*	Rubber rabbitbrush
CHVI	*C. viscidiflorus*	Low rabbitbrush
GRSP	*Grayia spinosa*	Spiny hopsage
POTR	*Populus tremuloides*	Quaking aspen
PRVI	*Prunus virginiana*	Common chokecherry
PUTR	*Purshia tridentata*	Antelope bitterbrush
RIBES	*Ribes spp.*	Currant
ROWO	*Rosa woodsii*	Woods rose
SALIX	*Salix spp.*	Willow
SYOR	*Symphoricarpos oreophilus*	Mountain snowberry

APPENDIX I (con't)

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Forb Species	
ACLA	*Achillea lanulosa*	Yarrow
AGGL	*Agoseris glauca*	Pale agoseris
ALBI	*Allium bisectum*	Twincrest onion
ALLIU	*Allium* spp.	Wild onion
ANAR	*Antennaria arcuata*	Arching pussytoes
ANRO	*A. rosea*	Rose pussytoes
ARAC	*Arenaria aculeata*	Prickly sandwort
ARHO	*Arabis holboelii*	Holboell rockcress
ARLU	*Artemisia ludiviciana*	Sagewort
ASTER	*Aster* ssp.	Aster
ASAG	*Astragalus agrestis*	Agressive locoweed
ASOB	*Astragalus obsurus*	Arcane milkvetch
ASPU	*Astragalus purshii*	Pursh locoweed
CIFO	*Circium foliosum*	Elk thistle
CIVU	*C. vulgare*	Bull thistle
COPA	*Collinsia parviflora*	Little flower collinsia
CRAC	*Crepis acuminata*	Tapertip hawksbeard
CRIN	*Crepis intermedia*	Gray hawksbeard
CRCI	*Cryptantha circumscissa*	Matted cryptantha
CRHU	*Cryptantha humilis*	Cryptantha
CRYPT	*Cryptantha* spp.	Cryptantha

APPENDIX I (con't)

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Forb Species	
CYMOP	*Cymopterus* spp.	Spring parsley
DEPI	*Descurainia pinnata*	Pinnate tansy mustard
DESCU	*Descurainia* spp.	Tansy mustard
EPPA	*Epilobium paniculatum*	Autumn willowweed
ERDI	*Erigeron divergens*	Spreading fleabane
ERIGE	*Erigeron* spp.	Fleabane
ERCA	*Eriogonum caespitosus*	Mat eriogonum
ERLE	*Eriogonum lewisii*	Lewis eriogonum
ERLI	*Erigeron linearis*	Slenderleaf fleabane
ERIOG	*Eriogonum* spp.	Wild buckwheat
FRAGA	*Fragaria* spp.	Strawberry
HALA	*Haploappus lanceolatus*	Lanceleaf goldenweed
IRMI	*Iris missouriensis*	Rocky Mountain iris
IVAX	*Iva axillaris*	Poverty sumpweed
LEPU	*Leptoactylon purgens*	Prickly phlox
LUCA	*Lupinus caudatus*	Tallcup lupine
LUPIN	*Lupinus* spp.	Lupine
NAVAR	*Navarretia* spp.	Navarretia
OECA	*Oenothera caespitosa*	Tufted evening primrose
OPPO	*Opuntia polyecantha*	Plains prickly pear
PEHU	*Penstemon humilus*	Low penstemon
PENST	*Penstemon* spp.	Penstemon
PHLOX	*Phlox* spp.	Phlox

APPENDIX I (con't)

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Forb Species	
PLANT	*Plantago* spp.	Plantain
PODO	*Polygonum douglasii*	Douglas knotweed
POGR	*Potentilla gracilis*	Northwest cinquefoil
POPE	*P. pectinisecta*	Combleaf cinquefoil
POTEN	*Potentilla* spp.	Cinquefoil
RACY	*Ranunculus cymbalaria*	Rocky Mountain buttercup
SPAM	*Sphaeralcea ambigua*	Desert globemallow
THAR	*Thlaspi arvense*	Field pennycress
VETH	*Verbascum thapsus*	Flannel mullein
WYAN	*Wyethia amplexicaulis*	Mulesear wyethia
ZYPA	*Zygadenus paniculatus*	Foothill deathcamas

APPENDIX I (con't)

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Grass and grass-like species	
AGST	*Agrostis stolonifera*	Redtop
AGDA	*Agropyron dasystachyum*	Thickspike wheatgrass
AGDE	*A. desertorum*	Crested wheatgrass
AGSM	*A. smithii*	Western wheatgrass
AGSP	*A. spicatum*	Bluebunch wheatgrass
AGSU	*A. subsecundum*	Bearded wheatgrass
AGTR	*A. trachycaulum*	Slender wheatgrass
BROMU	*Bromus* spp.	Brome
BRCA	*B. carinatus*	Mountain brome
BRTE	*B. tectorum*	Cheatgrass brome
CAREX	*Carex* ssp.	Sedge
DECA	*Deschampsia caespitosa*	Tufted hairgrass
DIST	*Distichlis stricta*	Saltgrass
ELEOC	*Eleochoris* spp.	Spikerush
ELCI	*Elymus cinereus*	Great basin wildrye
FEID	*Festuca idahoensis*	Idaho fescue
HEKI	*Hesperocloa kingii*	Spike fescue
HOBR	*Hordeum brachyantherum*	Meadow barley
JUNCU	*Juncus* spp.	Rush
MELIC	*Melica* spp.	Oniongrass
MURI	*Muhlenbergia richardsonis*	Mat muhly
ORWE	*Orysopsis webberi*	Webber ricegrass
POA	*Poa* spp.	Bluegrass
POCU	*P. cusicki*	Cusick bluegrass

APPENDIX I (con't)

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Grass and grass-like species	
POLI	*P. leibergii*	Leiberg bluegrass
PONE	*P. nevadensis*	Nevada bluegrass
POPR	*P. pratensis*	Kentucky bluegrass
POSA	*P. sandbergii*	Sandberg bluegrass
SIHY	*Sitanion hystrix*	Bottlebrush squirreltail
STCO	*Stipa columbiana*	Columbia needlegrass
STLE	*S. lettermani*	Letterman needlegrass
STTH	*S. thurberiana*	Thurber needlegrass

APPENDIX I (con't)

SYMBOL	
Ground cover characteristics	
VEG	Vegetation
BG	Bare ground
NPL	Non-Persistent litter
PL	Persistent litter
ROCK	Rock
PAVE	Pavement
CRYP	Cryptogam
COP	Coppice
INTER	Interspace

Appendix II Wildlife species mentioned in text of the sage grouse, mule deer, or non- game reports and/or identified at the Saval Ranch for the first time in 1981.

Mammals

Order	Family	Species (Scientific name)	Common name
Artiodactyla	Cervidae	Odocoileus hemionus	Mule deer
Carnivora	Canidae	Canis latrans	Coyote
Insectifora	Soricidae	Sorex merriami[1]	Merriam shrew
		S. palustris	Northern water shrew
		S. vagrans[1]	Vagrant shrew
Lagomorpha	Leporidae	Lepus californicus	Black-tailed jackrabbit
Rodentia	Cricetidae	Lagurus curtatus	Sagebrush vole
		Microtus montanus	Mountain vole
		Onychomys leucogaster	Northern grasshopper mouse
		Peromyscus maniculatus	Deer mouse
		Reithrodontomys megalotis	Western harvest mouse
	Heteromyidae	Perognathus parvus	Great Basin pocket mouse
		Dipodomys ordii	Ord kangaroo rat
	Sciuridae	Eutamius minimus	Least chipmunk
	Zapodidae	Zapus princeps	Western jumping mouse

Birds

Gallitormes	Tetraonidae	Centrocercus urophasianus	Sage grouse
Apodiformes	Trochilidae	Selasphorus platycercus	Broad-tailed hummingbird
	Charadriidae	Charadrius vociferus	Killdeer
Cioconiiformes	Threskiornithidae	Plegadis chidi[1]	White-tailed ibis
Columbiformes	Columbidae	Zenaida macroura	Mourning dove
Passeriformes	Alaudidae	Eremopila alpestris	Horned lark
Passeriformes	Fringillidae	Amphispiza belli	Sage sparrow
		Carduelis tristis	American goldfinch
		Chondestes grammacus	Lark sparrow
		Melospiza melodia	Song sparrow
		Passerina amoena	Lazuli bunting
		Pheucticus melanocephalus	Black-headed grosbeak
		Passerella iliaca	Fox sparrow
		Pipilo chlorurus	Green-tailed towhee
		P. erythrophthalmus	Rufous-sided towhee
		Pooecetes gramineus	Vesper sparrow
		Spinus pinus	Pine siskin
		Spizella breweri	Brewer's sparrow
		Zonotrichia leucophrys	White-crowned sparrow

Birds (Continued)

Passeriformes	Icteridae	Euphagus cyanocephalus	Brewer's blackbird
		Icterus bullockii	Bullock's oriole
		Sturnella neglecta	Western meadowlark
	Laniidae	Lanius ludovicianus	Loggerhead shrike
	Mimidae	Oreoscoptes montanus	Sage thrasher
	Paridae	Parus gambeli	Mountain chickadee
	Parulidae	Dendroica petechia	Yellow warbler
		Icteria virens	Yellow-breasted chat
		Oporornis tolmiei	Macgillivray's warbler
		Vermivora celata	Orange-crowned warbler
	Troglotidae	Salpinctes absoletus	Rock wren
		Troglodytes aedon	House wren
	Turdidae	Hylocichla fuscescens	Veery
		H. guttata[1]	Hermit thrush
		Turdus migratorius	Robin
	Tyrannidae	Contopus sordidulus	Western wood pewee
		Empidonax(sp)	
		Sayornis saya[1]	Say's phoebe
	Vireonidae	Vireo gilvus	Warbling vireo
Piciformes	Picidae	Colaptes cafer	Red-shafted flicker
		Dendrocopus pubescens	Downy woodpecker
		Sphyrapicus varius	Yellow-bellied sapsucker

Fish

	Salmonidae	Salmo clarki	Humboldt cutthroat trout (Taxonomic work on this species is not complete, however it is closely related to the Lahontan cutthroat)(S.c. henshawi)

[1]Species identified at the Saval Ranch for the first time.

APPENDIX III

English to metric conversion table for units used

in the 1981 Saval Ranch Research and Evaluation Progress Report

To Convert:	Into:	Multiply by:
Acres	Hectares	.4047
Feet	Meters	.3048
Inches	Centimeters	2.5400
Inches/day	Centimeters/day	2.5400
Miles	Kilometers	1.6090
Number/acre	Number/hectare	2.4710
Number/square mile	Number/square kilometer	2.4710
Pounds	Grams	453.5924
Pounds	Kilograms	.4536
Pounds/acre	Grams/hectare	1120.8115
Pounds/acre	Kilograms/hectare	1.1208
Square feet	Square meters	.0929
Square mile	Square kilometer	2.5900
Temperature (°F) -32	Temperature (°C)	5/9